M. Ashley

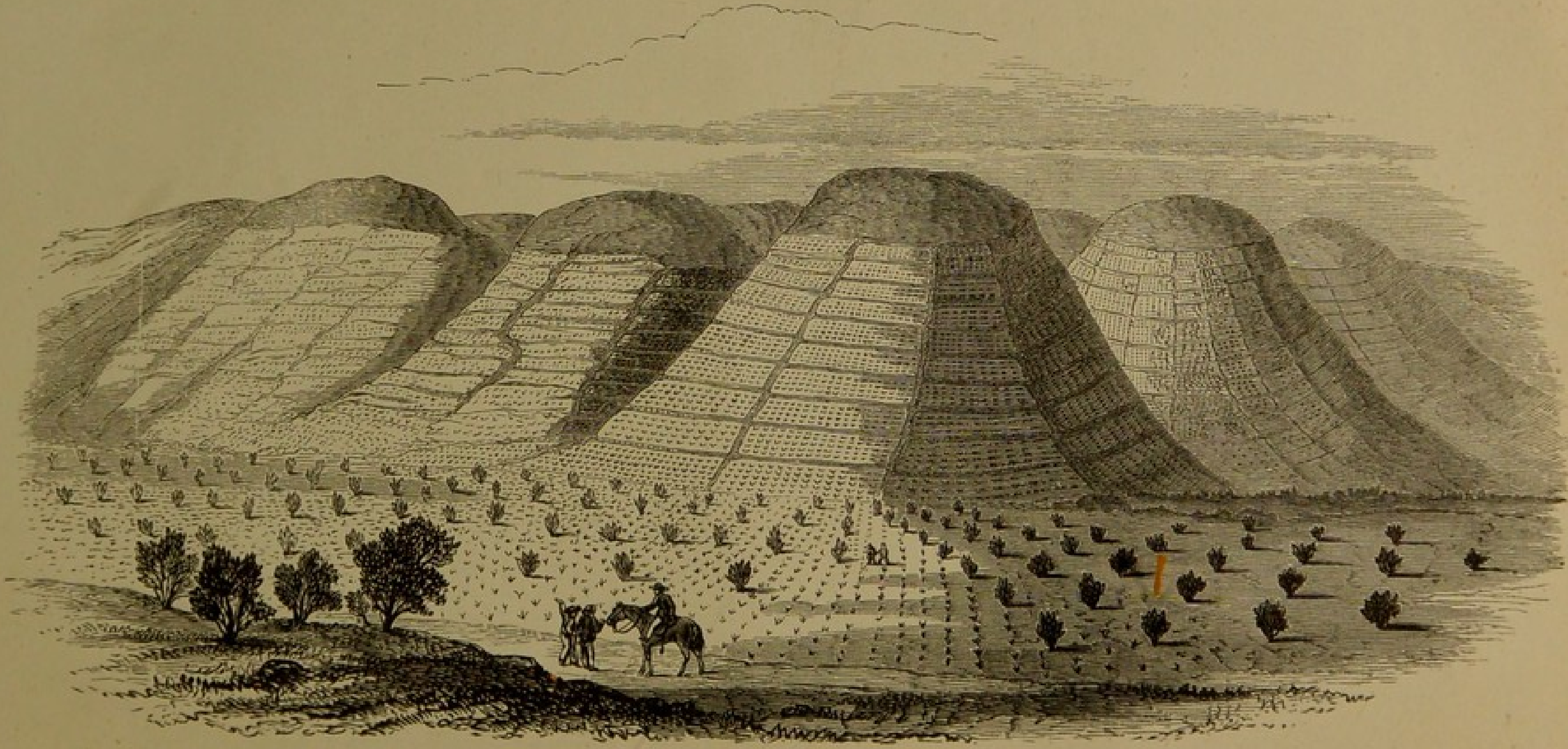
A TREATISE

ON THE

ORIGIN, NATURE, AND VARIETIES

OF

WINE.



VINEYARDS OF BANYULS, PORT-VENDRES, AND COLLIOURE (DEPARTMENT OF THE PYRÉNÉES ORIENTALES).

A TREATISE

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ORIGIN, NATURE, AND VARIETIES

OF

WINE:

BEING

A COMPLETE MANUAL OF VITICULTURE AND ŒNOLOGY.

BY

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PREFACE.

In presenting this treatise to the public, the Authors have hardly any statement to make which is not contained or implied in the work itself. Nevertheless, as the title may fail in conveying fully the scope and intensity of their labours, they beg leave to supplement it by a short preliminary statement of the principles by which they have been guided. In the first place, the Authors determined to produce a strictly scientific work, based as far as possible upon their personal observations. Such have therefore been made in the vineyards, cellars, and repositories of many countries, in the respective chemical laboratories of the Authors, in public and private gardens, in open nature, and in mines underground. Wherever possible, they availed themselves of the writings of previous authors for the purpose of guiding or supplementing their observations, and with that object they have consulted and used nearly two hundred out of the six hundred works which compose the world's œnological literature.

The Authors next endeavoured to give due proportions to each of the elements of their treatise, so as to make it useful to the greatest possible number of readers. The planters of Australia or America will therefore find in it a concise exposition of the principles of viticulture and vinification, by the aid of which they may attain the best products of which their climate may admit; but they will also have before them faithful pictures of the viticulture of the principal wine districts of the world, which they may use as patterns for imitation, if disinclined to rely upon general principles. The wine merchants of Great Britain and of America will find accurate descriptions of the objects of their trade, together with such topographical and statistical information as may aid them materially in enlarging the field, or the certainty, or the profits of their operations; and rendering still more important services to the public for which they have hitherto provided, or hope in future to provide. All persons who are fond of wine as an article of diet and a means of enjoyment, will be able to find in this treatise information about the origin and varieties of wine, which will enable them to regulate their wants with due reference to their liking and their means. They will find that the Authors have had amongst their aims the accomplishment of one of the most benevolent intentions of the Legislature; namely, to make accessible to the people at large, the wines of all countries which can be used as beverages, and which by the voice of science and the practice of entire nations are declared preferable by far to distilled spirit or to wines fortified by such. While thus assuming a distinct position with regard to a well-understood social question, the Authors have abstained from a zealous exaggeration, and have, on the contrary, endeavoured to preserve that judicial calmness which distinguishes the natural historian. The same moderation they have applied to practices such as the plastering of must and wine, for which, after the most searching investigation, they have been unable to find any logical grounds; nay, for which those who are most addicted to them cannot adduce a single reason or pretext. An improved vinification by the guidance of science will of itself cause such practices to fall into desuetude, even if their results were not prejudicial to the quality of the products or the health of the consumers.

The Authors have endeavoured to impress strongly upon the minds of their readers that there is an indissoluble connection between the grape and the wine which it yields. The genius of wine is in the grape; every kind of vine gives a distinct character to its product. For this reason the most renowned wines are all made from distinct varieties of grapes, which are never mixed with indifferent or heterogeneous varieties. The greater the number of varieties of grapes which participate in the production of a certain wine, the less character possesses the product. All wines should, therefore, be described in such a manner that the grapes from which they are made constitute the first term of the description. Wine from Palomino grown at Xeres differs greatly from wine made from the Mantico castellano grown in the same district. How, then, can such wines be adequately described by the expression "Sherry"? Wine from Carbenet Sauvignon differs greatly from the wine produced by the Verdot and Malbec. Is it not unreasonable to confound these products under the term "Claret"? The wines of Riessling and of Traminer are distinct products of the Rhine country. Is it not time to abandon or amend the designation of "Hock," so as to maintain the emphatic originality of each variety? The adoption of this principle will go far to put an end to adulteration and imitation. The more the product of a distinct variety of vine becomes obscured by mixing, sweetening, or brandy, the easier it can be imitated. But the thoroughly fermented, unsugared, and unbrandied wines of Palomino, Semillon, Riessling, Formint, of the Pineau, Bastardo, Verdot, Carmenet, Grenache and Tinto, cannot be imitated by the most expert wine-cooks. Take away their brandy, their sugar, caramel, elder, and logwood, and their imposture is at an end.

It is thus not difficult to see in what direction the taste of the educated or informed part of the people will in the future be developed. The days of the heavily-brandied wines are numbered, since it is proved that the wines of Xeres and Oporto can be brought into a merchantable condition without extraneous spirit. As the habits of the people get softened, so they decrease both the quantity and strength of the alcoholic liquids which they consume, and insist upon increasing quality and differentiation of their beverages.

Persons interested in the maintenance of abuses have frequently attempted to uphold them by statements which they themselves did not always believe to be true. The greatest difficulty in the way of our inquiries has been the frequent misrepresentations on the part of producers and merchants regarding the natural alcoholicity of the wines of South Europe. We have dispelled this fog by relying, not upon men or their wines, but upon the scrutiny of musts by the gravimeter. We are sorry to find, that there is some tendency on the part of Australian producers to mystify the public regarding the natural strength of their wines, but rejoice that there are others who by the publication of the observations concerning the strength of their musts enable us to maintain for Australia also the validity of our general scientific conclusions.

In the course of our studies we have met with much support on the part of British and foreign merchants and producers interested in the subject. Our warmest thanks are due to the Messrs. W. and A. Gilbey, who have greatly assisted us throughout our labours, and given us such opportunities as we should not otherwise have enjoyed. We also fulfil a pleasant obligation by expressing our thanks to Monsieur Auguste Meller of Bordeaux, Monsieur Emile Perrier of Châlon sur Marne, and Herrn Rudolph Henckell of Mayence, for the great assistance given to us in our studies of the viticulture of the Gironde, the Champagne, and the Rhine.

Many are the friends, acquaintances, and strangers in almost all parts of the world, who supplied us with practical or literary notes, or hints and materials. To all of them we express our best thanks at this agreeable moment of the conclusion of our long and arduous, but faithful and pleasant labours.

We have also to acknowledge the care and attention bestowed on the woodcuts by Mr. J. D. Cooper and Mr. Collings.

October 1871.

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A TREATISE

ON

THE ORIGIN, NATURE, AND USE OF WINE,

ETC.

CHAPTER I.

ORIGIN AND PHYSIOLOGY OF VINES.

Indigenous vines of European countries.—Probable derivation of cultivated vines from indigenous varieties.—Fossil vine and grapes.—Geographical distribution of cultivated vines on the northern hemisphere.—Mineral constituents of the vine.—Influence of the soil on the mineral constituents of the vine.—Amount of mineral matter which viticulture abstracts from the soil.—Organic ingredients and chemical development of the vine.—Special investigation of the relation of acid and sugar in grapes during ripening.

INDIGENOUS VINES OF EUROPEAN COUNTRIES.

MOST botanical authors have assumed that all the vines of Europe are derived from one particular species, the *Vitis vinifera*, which they imagine to be a native of Asia, and to have been imported into the Western world in prehistoric times. The primary grounds for this surmise were perhaps the Semitic traditions of Paradise, and the Greek *mythos* of the migration from India to Hellas of the wine-god Dionysos. From Greece the vine was supposed to have come to Italy, and from this latter country to have been imported into France and Germany by the agency of historical colonization. Whenever a German botanist met with a wild vine in the

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Rhine valley, he explained its existence by the assumption that it was a degenerated offspring of vines carried thither by the Romans; and, inversely, enthusiastic antiquarians declared the presence of these plants in the marshes of the Rhine valley as relics, nay, even as evidence of the former existence of Roman settlements. This opinion obtained almost universal credence, until Gmelin, in elaborating the "Flora Badensis," observed that the wild vine frequently occurred in the dioic state. He then described such plants botanically, and gave them a separate place in his treatise under the special name of *Vitis sylvestris.* In most botanical works which appeared subsequently to Gmelin, the *Vitis sylvestris* is quoted after him, but the discovery is mostly neutralized by the remark that the *Vitis sylvestris* was nothing but a degenerated *Vitis vinifera.* Other botanists, amongst them Reichenbach, fell into the error of confounding the American vine, the *Vitis labrusca,*—the first variety which Linné accepted by the side of the *vinifera,*—with the *sylvestris.* This singular failure of able botanists is the more astonishing, since Crescentius,[1] who lived in the thirteenth century at Bologna, and wrote a compendium on the Italian vines, stated that he had met with many varieties of wild vine in Italy, which appeared to him to be peculiar sorts; and Clemente,[2] in his work on the vines of Andalusia, recognized the peculiar character of the wild vines of his country, and believed them to be indigenous to it, and consequently to have existed there previous to the introduction or origination of the cultivated species. He expresses himself very strongly against the limitation of botanists who assume only one *Vitis vinifera,* and refer all other varieties to a play of nature. He says that in the neighbourhood of Algaida, near Sanlucar de Barrameda, there grow in the wild state different kinds of vines which are perfectly characterized. He refers to their varying ages, and points out that the young plants have the same characters as the old ones. From this

[1] Petrus de Crescentiis, Opus ruralium commodorum: Augsburg, 1471; Louvain, 1474.

[2] Simon Roxas Clemente was Director of the Royal Botanical Gardens, Madrid.

he further argues that they have probably preserved these same characters through an inconceivable series of centuries during which countless generations have been propagated by seed. He describes how, in the lower parts of the district, where there are sources of sweet water not far from the surface of the earth, the wild vine forms impenetrable thickets, grottoes, covered walks, winding footpaths, walls, arches, pillars, and by means of other plants, particularly trees, other original shapes, which it is impossible to describe. He states that it cannot be proved by any document that a vine has ever been planted in this neighbourhood in former times. What he says about the improbability of the Arabs having brought the vine thither is perhaps irrelevant, as he bases his argument upon the fact of wine having been forbidden to them by their religion. They might have cultivated it for the sake of the grapes and raisins. But the strongest argument in favour of his opinion is the small resemblance which these wild species of Algaida vines have to the cultivated varieties of the south of Spain. He thereby eliminates the idea that the first seed of these plants had been carried to these marshes from neighbouring vineyards, within a period not far distant from the time when he (Clemente) wrote, by the agency of men, or animals, or other means.

In Provence, Languedoc, and Guyenne there grow many wild vines on hedges, in jungles, or in woods and forests. According to Duhamel,[1] they differ from the cultivated varieties by their leaves being in general smaller, and more cottony on the surface, and particularly by their fruit being much smaller, and of a less soft and sugary taste. These wild vines, to which the ancients had given the name of "labrusca," are yet known in the present day in the south of France, under the name of "Lambrusco" and "Lambresquiero."

In the forests which border the marshy shores of the Rhine, between Mannheim and Rastadt, there grow many thousands of wild vines, which, as far as they had been observed at all, were, like the *Vitis sylvestris* of Gmelin, declared by botanists

[1] Duhamel de Monceau, Traité des Arbres fruitiers, p. 212.

to be degenerated vines disseminated from human plantations, through the agency of birds and men. This error was dispelled by the investigations of that distinguished œnologist, the late J. P. Bronner, of Wiesloch, near Heidelberg. He studied these children of the forest in their natural haunts during several years; he visited them in early summer-time, and selected from the many thousand individuals the types of inflorescence and multifarious forms of leaves; he marked the places of their abode, and returning in the fall saw and tasted the grapes, which had then come to maturity. After devoting years to the observation of the several constant varieties, he took cuttings from them and planted them in his garden at Wiesloch in order to observe their bearing in the state of cultivation.[1] He had thus planted thirty-six varieties, when in the year 1842, a very favourable wine-year, most of his plants bore very perfect fruit, and brought it to the utmost maturity. None of these plants had changed their original character by cultivation. Bronner caused accurate pictorial representations of their fruit to be made. Already, during the time of blossoming, he had obtained faithful portraits of the flowers, leaves, and branches by a kind of nature printing, and when these were coloured by the artist the whole formed a complete botanical atlas of the wild vines of the Upper Rhine valley.[2]

[1] In the autumn of 1866 one of us visited this vineyard at Wiesloch, and in company with its present proprietor, the son and successor of the late M. Bronner, examined a considerable number of these children of the Rhine marshes. Leaves, fruit, and habit admitted of the direct identification of several species described in the following pages, particularly the barren varieties, and the varieties with inedible or very acid fruit at once struck the eye. The *Schamsia ligustrica* could be diagnosed at the first glance. Several varieties had perished, and several could not any longer be identified. M. Bronner, for whose courteous and friendly reception we feel deeply grateful, freely acknowledged not to have inherited the enthusiasm for œnology which characterized his father. But he kept the remarkable vineyard, with its hundreds of rose-trees overtopping the vines, in the condition to which his father had raised it. In the lower garden the visitor admired the splendid "blue Wildbacher" vine, which had overgrown an entire large pear-tree, and without ever having been pruned had brought a harvest which it had taken two men two days to cut down.

[2] This atlas is now in the Library and Museum of the Œconomical and Agricultural Society of Baden, at Karlsruhe.

At the same time Bronner made an accurate botanical diagnosis of, and attributed a suitable Latin name to each variety, and arranged the whole in a special system, based upon the construction of the flowers and the formation of the fruit.

The inflorescence of these wild vines shows three distinct forms. A considerable number of plants exhibit only a male inflorescence without any umbilicus capable of fructification; in the place where there should be a beginning of a berry, there is a yellow receptacle with honey. The plant produces an enormous number of blossoms, each of which is several inches in length, and with its long yellow stamina and terminal pollen bags resembles a brush such as is used for cleaning bottles. The flowers distribute a most agreeable odour around the plant.[1]

A certain number of the other vines have exactly the same inflorescence as the cultivated vines; they are hermaphrodite, with long projecting yellow stamina and pollen bags, and an umbilicus capable of impregnation. The leaves of these vines differ but little from those of the cultivated varieties, but the fruit has a different shape and a different chemical nature, being often very acid and sometimes quite inedible.

But the great majority of individuals as well as species of wild vine has a most peculiar inflorescence, differing considerably from the two forms just described. On looking upon an active blossom of this class, the spectator receives the impression that it is an undeveloped bunch of buds, from which the ordinary cover of the flower, the so-called crown or cap, which the cultivated vine always sheds completely, had not yet been thrown off. On close examination it is however seen that the cap is actually detached, although it remains hanging upon the flower, and the stamina are seen bent downwards below the basis of the future fruit. The stamina become, as botanists technically term them, "stamina recurvata," and thus greatly differ in appearance from the "stamina

[1] Compare with this description the account which Pliny gives of the "œnanth," alluded to in the historical division of this treatise.

erecta" of the wild unproductive variety above described, and of the hermaphrodite wild and cultivated plants.

It is to be regretted that Bronner did not study the physiological relations of the male plants with erect stamina to those which showed the "stamina recurvata," the more so as he himself surmised that these latter plants are unable to

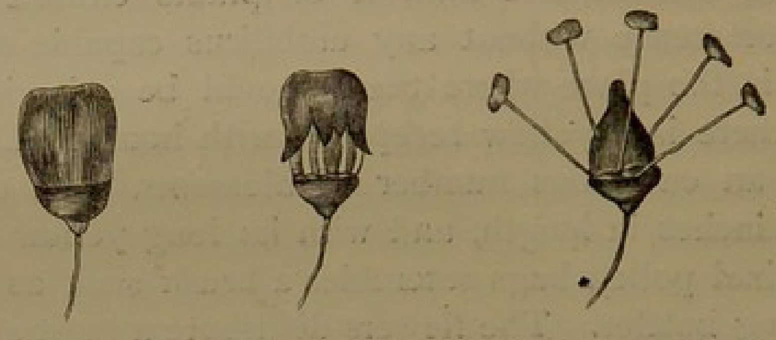

FIG. 1.—Inflorescence of Hermaphrodite Wild and Cultivated Vines. (Magnified by lens.)

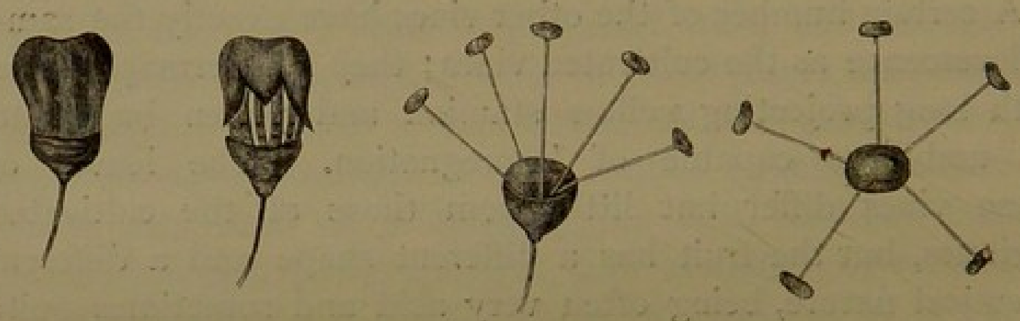

FIG. 2.—Inflorescence of Male or Sterile Wild Vines, with open honey-cup in place of fruit. (Magnified by lens.)

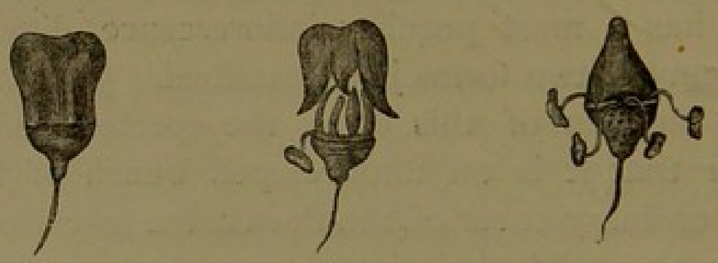

FIG. 3.—Inflorescence of Female or Fructiferous Wild Vines, with recurved stamina. (Magnified by lens.)

fructify themselves, but require the male plants for fructification. The transfer of the pollen from the male to the female individuals, which are mostly standing at a distance from each other, is very probably effected by the agency of insects. The male plants seem to belong to different species or varieties, as indicated by differences in their leaves. But these were not particularly inquired into by Bronner. The male plants were perhaps capable of fructifying any of the female plants, and thus producing new varieties by crossing.

It will be seen from our account of the American vines that they also occur in the polygamic as well as the dioic state. Monographers do not admit this to be a characteristic feature, but hold it to be an accident to which any variety may be subject.

In the vineyards of the department of the Ain, in France, a variety of vine is cultivated which is termed the "mescle." It has long bunches of oval grapes and deeply lobated leaves, mostly with five divisions. Each of these divisions or lobes is provided with a considerable expanse of vegetable membrane on both sides of the principal so-called nerve in every case in which the plant is fertile; but a leaf with a narrow strip of membrane on both sides of the nerve indicates a sterile plant. The plants can be easily distinguished, even at a distance, with the help of the following engravings.

FIG. 4.—Leaves of Sterile "Mescle."

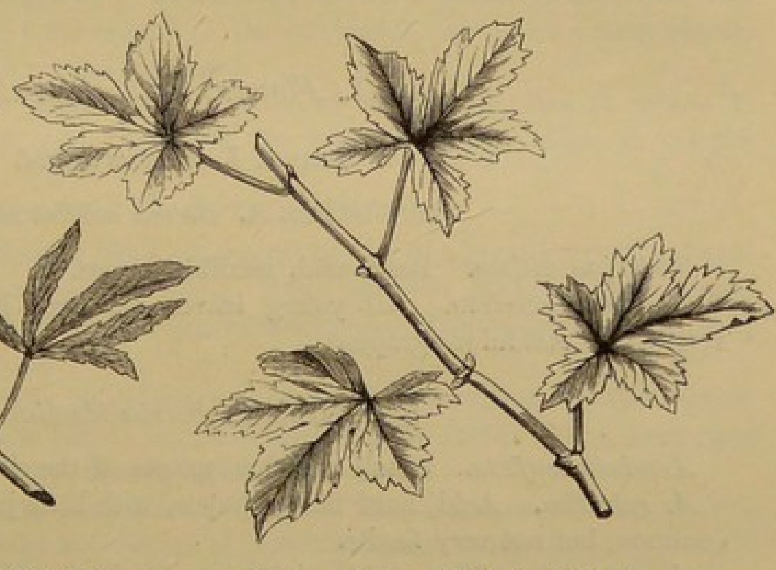

FIG. 5.—Leaves of Fertile "Mescle.

The plants indicated by Fig. 4 are absolutely and always sterile, and the vine-dressers term them "plants craputs." They grow luxuriant branches, and the apparently crippled character of their leaves is no indication of any general want of vigour. Their cuttings and pro-vines are as sterile as the parent stocks. The vine-dressers in the Ain have a fable to account for this peculiarity; namely, that it is produced by planting canes which have grown from old wood. Guyot,[1] who noticed the fact, was as unable to account for it as the vine-dressers, and laboured to establish a relation between the expanse of the leaf and the fecundity of the shrub. We think, however, that the sterile mescle will be found to be the male, and the fertile either the female or hermaphrodite. In this we are confirmed by the curious circumstance that no vine-dresser dares totally to extirpate the sterile mescle from his vineyard, although he abstains from increasing the number of individuals.

Bronner divided the hermaphrodite indigenous wild vines of the Rhine valley into two classes. The first class comprises those which have flowers with recurvate short stamina. The orders and varieties are determined by the shape and colour of the berries. The second class comprises the vines with flowers bearing long erect stamina. The orders are again determined as before.

CLASS I. *Flowers with short stamina.*

ORDER I. *Berries round.*

SUB-ORDER A. *Berries reddish blue.*

Berberina villosa. Bears acid, inedible grapes.

Tyrtamia revoluta. All young leaves are bent back at the margin, almost rolled in. Acidulous grapes.

SUB-ORDER B. *Berries blackish blue.*

Arminia confecta. Small acidulous grapes of the size of peas.

A. sylvatica. Acid, hard fleshy grapes, with little juice, almost inedible. Most common, but not very fertile.

A. obtusiloba. The middle lobe is very short and obtuse, as if cut off; very small bunch, from ½ to 1 inch in length; grapes a little sweet.

ORDER II. *Berries oblong.*

SUB-ORDER A. *Berries green.*

Maerklinia viridis. Bears green, almost inedible grapes.

[1] Rapport sur la Viticulture de l'Ain, p. 137.

SUB-ORDER B. *Berries blackish blue.*

Palatina dichotoma. Every fruit-stalk is divided into two equally strong branches. Grape acid.

P. oblonga. Oblong grape.

P. septemloba. Seven-lobed leaf.

P. Wisilocensis and *sylvestris* seem less well defined.

P. tilesifolia. Leaf like lime-tree leaf, undivided. Of this variety Bronner had also diagnosed the male.

P. sinuata. Deeply cut or sinuated leaf.

P. macrocarpa. Large bunch, like noirien.

P. dissecta. Deeply lobed and sub-lobed, so that the leaf consists almost of teeth only.

Dionysia isidorophylla. Leaf like that of Elbling. (*Isidora nobilis*, Burger.)

CLASS II. *Flowers with long stamina.*

ORDER I. *Berries round.*

SUB-ORDER A. *Berries green.*

Zaehringia nobilis. The grapes are as large as those of Riessling, and are yellow when ripe. They have a luscious sweet taste, with the flavour of orange-flower, on account of which Bronner termed them "the orange grapes."

SUB-ORDER B. *Berries reddish blue.*

Sickleria brevicirrhata. Grapes acid.

Elisabetha rubicunda. The grapes are reddish blue and of great size and fine shape. They have the peculiarity of the rose muscadine chasselas in this, that they turn red at an early period; the points of the old leaves, the entire young leaves, and the young wood bunch are all quite red.

Berberina venusta. The grape of this vine is of remarkable size (5 inches in length) and shape, but so acid that even the birds in winter refuse to eat the berries.

SUB-ORDER C. *Berries blackish blue.*

Heddæa mitissima. Splendid black grapes of the size of a great Burgundy grape.

Schamsia ligustrica. Leaf very small. Bays between leaves widely open. Grapes resemble greatly the fruit of *Ligustrum vulgare* (privet berry) in shape, size, and colour. Taste acidulous.

Noachia macrophylla. Very large leaves, 8 to 9 inches' diameter. Grapes sweet.

Ludovica cylindrica. The largest bunch of all wild vines on the Rhine, averaging 6 to 8 inches in length. Very suitable for cultivation.

Gockia crescentifolia. Leaf very similar to that of the Traminer.[1]

Thalesia rubrivenia. Ribs and nerves of leaves coloured red.

Dioscoridea grata. Grape agreeably sweet.

ORDER II. *Berries oblong.*

SUB-ORDER A. *Berries green.*

Leonhardia viridis. Peculiar in habit; strong vegetation.

SUB-ORDER B. *Berries blackish blue.*

Hlubeckia fertilis. Distinguished by particular fertility.

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[1] See description in chapter on "The Palatinate."

On comparing the fructiferous hermaphrodite flowers of the wild vines with those of the cultivated varieties, no particular difference can be observed. The shapes of their leaves are also very analogous. The great difference between them appears in the bunches of grapes. Not a single bunch of grapes has been met with which could be said to be similar to or identical with any variety of the cultivated grapes of the Rhine valley. If the wild vines were degenerated seedlings of cultivated races, some at least amongst them might be expected to show the characters of the parent stock. A few indeed showed some similarity to known varieties in single parts, such as the leaves (see *Gockia crescentifolia* above); but in such a case the fruit differed completely.

On comparison of the habitual varieties of wild vines of the Rhine valley, it is found that the differences of external shape and intrinsic quality are very numerous, and concern the leaves, the flowers, and the fruit. The grapes are mostly *black*, and amongst many thousands of plants only three were found bearing *white* fruit. Of these one had *acid*, the other moderately sweet fruit; the third bore the delicious orange-flavoured grapes. The bunches of the two first white varieties were loose, pendulous, and carried long small berries; the orange-flower vine had bunches with densely placed grapes. Among the black varieties some bore very small bunches, not exceeding an inch in length. Others reached 2, 3, 4, and 5 inches, and thus became more like cultivated races. Most common were the black grapes of *oval* shape; all these were ranged under the generic name of *Palatina*.

The shapes of the leaves also differed greatly. The *Tilecifolia* had the perfectly undivided leaf which is most commonly seen on the vigorous shoots of the American *Vitis labrusca*. Starting from this, there were progressively found all kinds and degrees of divisions of the leaf up to seven lobes; and a complete splitting up of the vegetable membrane into teeth. This leaf reminded of the parsley-leaved royal muscadine, but the grape of this vine was black. The leaves of some varieties were kidney-shaped, others three-lobed, others five-lobed. The bays between the lobes were more or less developed.

Some leaves had no teeth on their margins, others had strongly serrate margins, and amongst these latter the *Noachia macrophylla* was most conspicuous.

In Upper and Lower Austria, particularly between Vienna and Presburg, there grow many wild vines on the shores of the Danube. Jaquin, in an article in the Austrian "Annals of Agriculture," showed years ago that there were growing on the islands in the Danube large numbers of wild vines bearing small grapes. Similar vines appear below Buda, and extend to Transylvania. The borders of the Theiss are enlivened by their presence; the Save, when it issues from Croatia, waters many plants of this kind. On the Adige, in the Tyrol, there are some jungles formed by wild vines which creep over low shrubs of *Rhus cotinus* and wild fig-trees. In the valley from Milan to Roveredo and Trient there are no wild vines whatever, but they appear where the Adige leaves the mountains and runs through a low marshy country.

From the foregoing, it is evident that all those European countries which possess the climatic conditions, have in their flora many species of the genus *Vitis* in a wild state, with such botanical characters as leave no doubt that the plants are indigenous, produced by natural selection, and not derived from imported cultivated races of vines, or degenerated by natural selection from previously cultivated races, the products of artificial crossing or human selection.

PROBABLE DERIVATION OF CULTIVATED VINES FROM INDIGENOUS VARIETIES.

Each particular district producing a particular kind of well-characterized wine, does so by means of particular well-characterized varieties of vines. These vines must be either indigenous to these districts or be produced in them by natural or artificial selection from indigenous varieties: for when transplanted to other districts they change their character more or less, so as to produce a different wine; or they lose their peculiarities so completely as to be worthless for making wine; or they cease to be fructiferous; or, lastly, they do not succeed at all, and pine and die out.

The "aramont" is commonly grown about Montpellier on account of its extraordinary fertility. Its bunches are large, its grapes of the size of nuts. Transplanted to the south of Germany,[1] the aramont begins to bear in the fourth year, and produces many and large bunches of grapes. But year by year its fertility decreases, and its berries become smaller, until the viticulturist is obliged to remove the barren plants.

Austria possesses four peculiar vines which are probably indigenous to the banks of the Danube. They are described by Burger [2] as follows:—

Plinia rubrivenia, the "Rothgipfler" of Upper Austria, is a vine with very dark foliage, the ribs, nerves, and points of which are red. At first sight it resembles the "Traminer," but its grapes are green.

Plinia austriaca, the green "Muscateller" of Upper Austria, is one of the most fertile vines in existence. Its bunches are large and bear small, greenish-yellow grapes. It is not cultivated in other parts of Austria.

Virgilia austriaca, or "the white one of Grinzing" (a village near Vienna), is only met with in the country round Vienna, where it is cultivated after the head-knob fashion.

Herera austriaca, or "red Zierifandler" of Vöslau, is cultivated only in the valley between Vienna and Baden, and not to any great extent. Its grape is light red, and is said to yield good wine. Bronner, who had become acquainted with these varieties, and particularly the fertility of the green muscateller, planted some vines of all four varieties in his vineyard at Wiesloch. During ten years he did not obtain a single grape from any of them, and after ten further years all the vines had died out.

The vines of Europe transplanted to North America do not succeed. Viticulture in that country is only possible with indigenous varieties or their crosses.

American vines, which yield good wine in the United States, when grown in the Gironde, degenerate, and yield no drinkable wine. M. Boucherot, of Carbonnieux, near

[1] Bronner, Die wilden Trauben, &c., p. 32.
[2] Burger, Joh., Oesterreich. Trauben. Wien, 1837.

Bordeaux, has made this experience by plantations on a large scale, and it is from himself that we have ascertained the circumstance.

The Riessling vine, transplanted to Portugal, is said to yield the "Bucellas" wine. Nobody would recognize Riessling in "Bucellas;" and if the common report of this transplantation (which, however, generally only refers to the "hock-grape") be correct, it proves that this vine so alters its character in the southern climate as to give an altogether different product.

Sherry is to a large extent made from a grape called the Pedro Ximenes, said to have been brought to Spain from the banks of the Moselle by the man whose name it bears. If this really be as related (and in view of the undetermined nature of the vines we reserve our judgment), this vine could only be the Albuelis or Elbling. In sherry, this ingredient can be as little recognized as any sherry-flavour can be discovered in Moselle. If the Pedro Ximenes is the transplanted Elbling, its fruit offers completely altered characters.

The vines of the Alto Douro differ in specific botanical character from all other vines, as port-wine differs from other wine. The Gironde produces the peculiar red wines by means of its carbenet, carmenere, malbec, and verdot. Transplanted to Spain, these vines do not produce claret any longer; in a climate less warm and less moist these vines so lose their fertility as to cease to be remunerative objects of agriculture.

What we intend here to show as a general proposition, illustrated by a number of striking examples, the reader can further examine in the course of his perusal of the topographical description of later chapters. Every uniform climatic region has its peculiarly adapted varieties of (wild and) cultivated vines, which cannot be so successfully cultivated in other regions, or cannot be cultivated at all anywhere else. But many varieties of vine, generally those of no particular qualities for wine-making, can be grown in a variety of districts, although in that case even it is necessary that these districts should have some climatic features in common.

FOSSIL VINE AND GRAPES.

The botanical argument contained in the foregoing pages appears to be almost incontestable, but its result is happily raised to absolute certainty by the testimony of rocks. This testimony proves that the wild vine existed certainly in Germany, and perhaps also in Bohemia and Tuscany, during the tertiary, and before the basaltic period. At Salzhausen, in Hesse-Darmstadt north of the Maine, there is a mine of so-called brown-coal or lignite. The shaft by which the coal is reached passes through 180 feet of solid basalt rock. The lignite fills a basin in tertiary strata, and consists of a great variety of decayed timber, shrubwood, and leaves imbedded in a clayey material. It is evident, from the nature of the bed and the arrangement of the lignite, that most of the wood and leaves have been produced on the spot, which was a jungle and morass, while another and smaller proportion of the lignite has been imported by the rivulet of a small valley. During the basaltic period this entire region became covered by a stream of lava, which at the particular spot of the shaft of the mine is about 180 feet thick. Now this lava belongs to the latest basaltic eruptions of that marvellous volcanic region, the Vogelsberg (mountain of birds), which rises to a height of 2,200 feet above the level of the sea. In the attempt to estimate the age of these formations, science experiences many difficulties, which we need not discuss, but it enables us to say that a hundred thousand years would be the shortest period which must have elapsed since the upheaving of these phonolithic and basaltic mountains. How many thousand years before this must have vegetated the vine in the jungle covered by the lava, can be approximately determined. For the geological data upon which such calculations can be based, we refer the reader to the essay of Tasché, in the Transactions of the Caroline Academy of Sciences.

The lignites of Salzhausen are mostly used for fuel, but there are portions of them which exclusively serve the

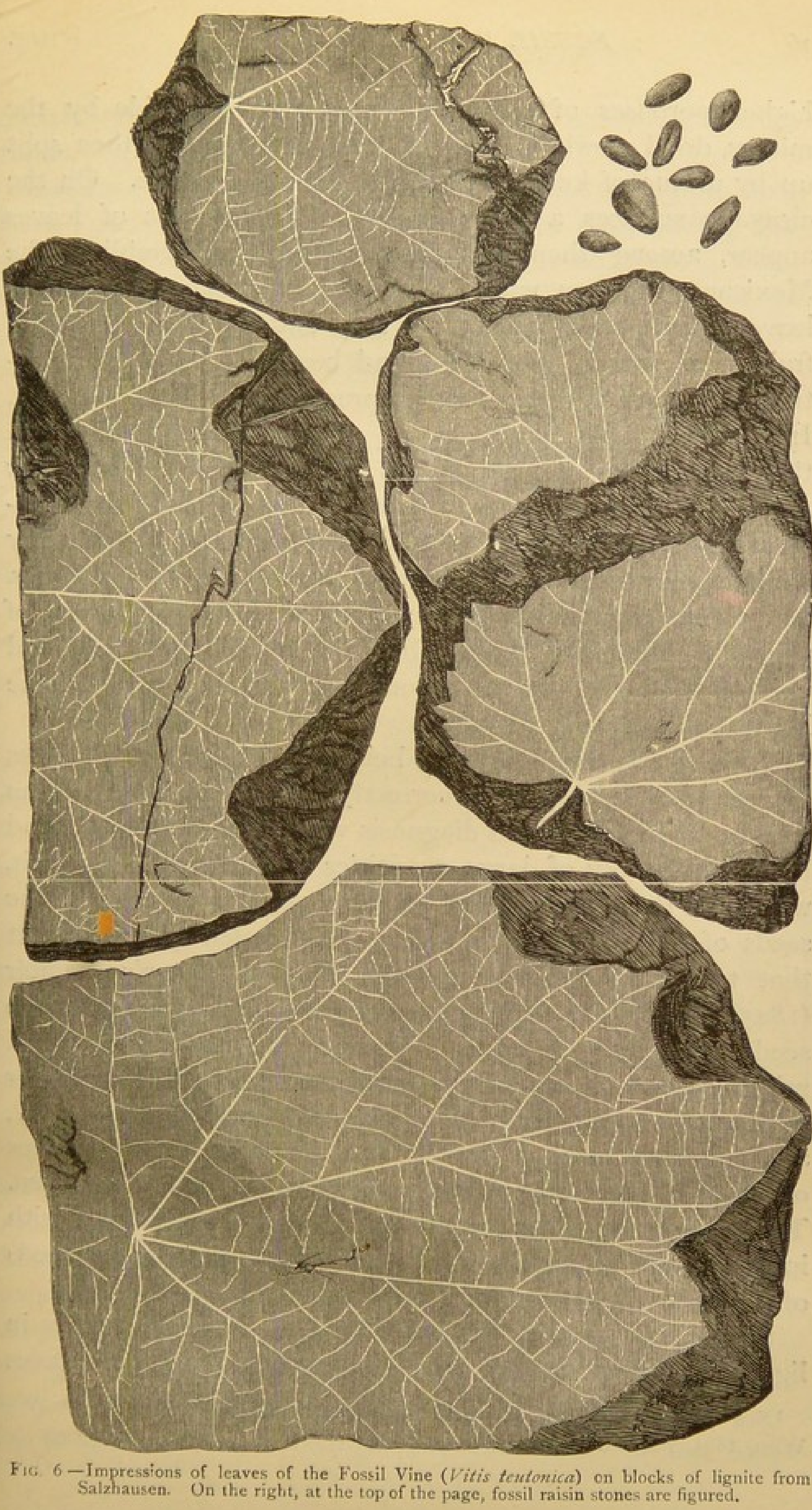


FIG. 6.—Impressions of leaves of the Fossil Vine (*Vitis teutonica*) on blocks of lignite from Salzhausen. On the right, at the top of the page, fossil raisin stones are figured.

higher purposes of science. These are laid aside by the miners, dried slowly to prevent their fissuring, and then split up by means of knives and chisels into thin plates. On the cleavage surfaces a great variety of impressions of leaves appear, among them peculiar oak-leaves resembling the Mexican evergreen varieties, species of smilax and anona, leaves of carya (a walnut-like tree) and its nuts, the small fruit of a pistacia, and the broad beautiful leaves of a fig-tree, with here and there the impression of a half-grown fig. Interspersed with these, or in separate layers, are found the impressions of the leaves of the fossil vine (*Vitis teutonica*). These leaves are of the size of medium vine-leaves, have stalks, and at their base are mostly unequally cordate, one side preponderating in size over the other. They are mostly imperfectly divided into five lobes, of which the anterior three lobes are more developed and pointed than the two posterior ones. The margins of the leaves are unequally dentated.

These leaves were formerly believed to belong to a species of acer,[1] but subsequently correctly interpreted by A. Braun as those of a vine. This diagnosis was particularly supported by the discovery of large quantities of seeds of berry-fruit, which, as the engraving shows, have great similarity to the seeds of Cissus and Vitis fruit. This similarity is so great that two years before the publication of Braun's memoir (1845), one of us, having incorporated a number of these seeds with his geological collection, labelled them "fossil raisin-stones." Some of the Salzhausen fruit-coal now in our possession represents a regular cake of murk; that is to say, a compressed mass of kernels and membranes, the residues of husks. Here and there indications of stalks are seen. There being no other variety of Cissus or Vitis met with in the lignite, we conclude that the Vitis-leaves and the seeds of the berry fruit come from the same plant.

Unger believes that the same kind of Vitis also occurs in lignite at Bilin in Bohemia, and states that the leaves

[1] See Unger, F., Sylloge Plantarum fossilium. Denksch. d. k. Akad. d. W.: Wien, 1861, vol. xix.

greatly resemble the leaves of *Ampellopsis tricuspidata* from Japan.

Gaudin ("Mém. sur quelques Gisements des Feuilles foss. de la Toscane") describes several species of Ampellideæ, and amongst them the *Vitis Ausoniæ*. This is no doubt a fossil vine; but as the leaves are much mutilated, it cannot at present be determined whether it is identical with, or different from, the *Vitis Teutonica*.

T E GEOGRAPHICAL DISTRIBUTION OF THE VINE ON THE NORTHERN HEMISPHERE.

The climatic conditions for the success of the vine are on the northern hemisphere united in a belt of territory enclosed

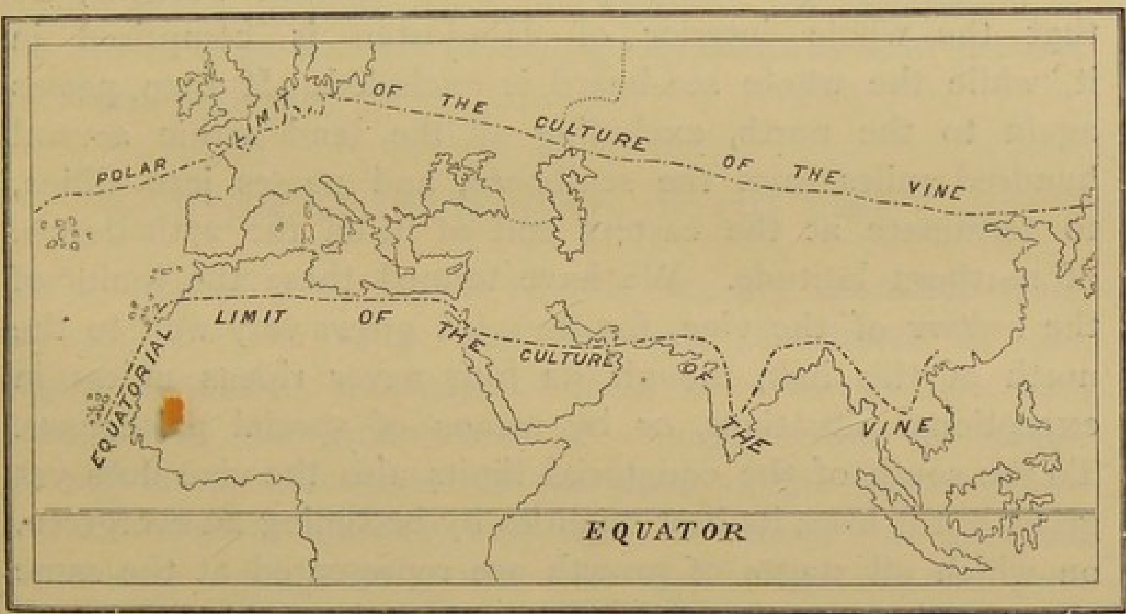


FIG. 7.—Polar and equatorial limits of the culture of the Vine in Europe and Asia.

between two lines, the northern of which we call the polar limit of the cultivation of the vine, and the southern the equatorial limit. The polar limit commences north of the Azores, keeps to the south of England without touching that country, enters France at Vannes in Brétagne, runs upon Mazières, and goes thence past Alençon and Beauvais. It then runs more northward, including a portion of Rhenish Prussia, passing to the north of Thuringia and the valley of the Saale to the north of Saxony, particularly of Dresden, and then runs across the Carpathians, through South Russia, almost in a straight line to the northern end of the Caspian Sea. Thence it proceeds in a straight line to the Amoor, and somewhat to the north of the southern bends of that river, ending in the Pacific Ocean. The equatorial limit begins near the equator in the Atlantic Ocean, and includes the Canary Islands and all the islands lying near the African and Spanish coast. It then enters Africa at about the 30th degree of northern latitude, and running nearly upon, though a little to the north of that degree, it leaves Africa at the middle of the Isthmus of Suez; runs across Arabia and the Persian Sea, enters India near the 25th degree of northern latitude, and then describes a loop running downwards in Hindostan itself, nearly parallel to its sea borders; so that the whole interior of Hindostan is comprised in it, while the whole sea-board is excluded. It then passes again to the north, excluding all the land within several hundred miles from the sea-board, and passes into China, to terminate at the eastern end of it, on the 27th degree of northern latitude. We have termed these the limits of the *culture* of the vine, for the vine grows very well to the north of this belt, though its fruit never ripens unless in exceptional situations, or by means of special protections. To the south of the equatorial limits also the vine does yet grow, but it loses its best qualities by becoming an evergreen, on which all stages of growth are represented at the same time; and under those circumstances it is unable to mature the fruit in the same manner and perfection as when it is subject to the rotation of the seasons.

The parallels, or means of the limits of the culture of the vine, do not coincide with any isothermal lines, for the vine requires not a certain high average temperature of the year, but a maximum of summer heat, without which the fruit does not ripen. There are many places in the viticultural belt, the average temperature of which is far below that of England, and yet they produce excellent wine. England does not produce wine because, although its average temperature is very high, its maximum summer heat is not high enough to ripen the grape. This is no doubt due to the circumstance that the large masses of water vapour which constantly pervade the air over Britain, prevent the rays of the sun from striking the soil with that effect which is required.

The cultivation of the vine in America is included, apparently, between similar limits. North of the 50th degree of latitude the indigenous American vines cannot be cultivated. The scuppernong does not succeed north of the Potomac, and the indigenous vines apparently do not pass south of the centre of Mexico.

We have not as yet any exact map showing the extent of the cultivation of the vine in the southern hemisphere. Peru produces wine; and so do South Africa (Cape of Good Hope) and Australia. How far, however, the cultivation of the vine in these districts extends geographically is at present not exactly known.

MINERAL CONSTITUENTS OF THE VINE.

The mineral constituents of the vine are extracted from the soil by the roots, and variously distributed in the plant. An exact knowledge of these is of the greatest importance to the viticulturist, as it enables him to adapt his soil to the necessities of the plant in the most perfect and economical manner, and thus to ensure the greatest possible production of grapes and wine. The mineral constituents of the vine are obtained as ashes by the combustion of its several parts. For the purposes of exact science, this incineration has to be effected with great care; the several parts have to be cleaned without being washed, and then to be dried at the temperature of boiling water to expel all moisture. The residue is weighed, and its proportion to the quantity of expelled water determined. It is then carefully burned in platinum vessels, and placed in the red-hot compartments (so-called muffles) of a furnace with a strong draught until a white ash is obtained. This ash consists of a part which is soluble in water, and of another which is insoluble.

The soluble part comprises the alkali metals, potassium and sodium, combined with carbonic acid, sulphuric acid, and chlorine; while the insoluble part contains calcium, magnesium, iron, and manganese, combined with carbonic, phosphoric, and silicic acid. These various substances are separated from each other by the special proceedings of analytical chemistry. It is thus found that the vine contains the same kinds of mineral ingredients as most other vegetables, but in different proportions. The proportions in the ash of the vine of alkalies to earths are about equal; and again, the united weight of these bases is about equal to, and sometimes exceeds somewhat the half of, the weight of the entire ash. Different vines yield different proportions of ash, but vines of the same kind, in full development and at the same period of vegetation, yield very similar proportions of ash. The ashes of the various parts of the vine, of leaves, branches, wood, and roots, differ from each other in a very striking manner.

Many researches[1] have shown that the ripe woody canes of the year's growth, at the termination of the vegetative period, *i.e.* during the winter, contain from one-fourth to one-fifth of their weight of moisture, or 25 to 20 per cent., and from 2·2 to 4·2 per cent. of ash. The older wood contains about the same proportion, but the roots contain a little more. The distribution of the mineral constituents in the various parts of the vine, at the period of the maturity of the grapes, is shown by the table on the opposite page.

In the first-named six parts the moisture was expelled at 100°, in the last seven at 110° C.

We thus perceive that the various organs of the vine assimilate different quantities and qualities of mineral matter. The leaves yield the greatest amount of ash, and the old wood and the ripe grapes the smallest. It is further observed that the less mineral matter a part contains, the greater is in that ash the proportion of soluble salts. The ash of the leaves is

[1] Boussingault, Ann. Chim. Phys. (3) 30, 369; De Vergnette, Bullet. de la Soc. d'Encourag., 1849, pp. 391, 468, 537; Hruschauer, Ann. Chem. Pharm. 54, 331; Walz (quoted by Mulder); Berthier, Ann. Chim. Phys. (3) 33, 249, and Chimie agricole; Crasso, Ann. Chem. Pharm. 57, 59, 62, 67; Levi, Ann. Chem. Pharm. 50, 421.

the highest absolute amount of ash yielded by any organ, and it contains the lowest percentage of soluble salts amongst all

Nature of the Organ.	Per cent. of moisture lost by drying.	Per cent. of ash.	Per cent. of soluble salts.	Per cent. of insoluble salts.	Soluble salts in 100 parts of ash.
Capillary root	63	6·0	0·6	5·4	10·0
Root 3 to 4 years old	47	2·8	0·4	2·4	14·2
Sunk cane, recently buried	45	3·0	0·4	2·6	13·3
Wood of old trunk	47	2·6	0·3	2·3	11·5
One year's wood	53	2·8	0·37	2·43	13·2
Pith	86	7·5	0·6	6·9	8·0
Leaves	68	11·7	0·7	11·0	5·9
Grape-stalks	66	6·0	0·4	5·6	6·6
Opaque green grape	65	5·0	0·6	4·4	12·0
Transparent do.	70	2·7	0·5	2·2	18·5
Ripe grape	72	2·6	0·4	2·2	15·3
Skin of grape	—	4·8	0·3	4·5	6·2
Stones of grape	25	2·7	0·2	2·5	7·4

the specimens of ash enumerated. The half-ripe grapes, on the other hand, contain a very low percentage of ash, and in this the maximum percentage of soluble salts enumerated in the last column. The leaves and wood are rich in potassium salts, while the bark contains much calcium carbonate. The pith and stones are rich in phosphate of calcium (De Vergnette).

The ash of the canes, of the murk, and of a litre of wine from one and the same vine, examined by Boussingault in 1848, yielded the following quantities of ingredients:—

Elements contained in the Ash.	Ash of canes in per cents.	Ash of murk in per cents.	Ash of 1 litre of wine in grammes.
Potash	18·0	36·9	0·842
Soda	0·2	0·4	—
Lime	27·3	10·7	0·092
Magnesia	6·1	2·2	0·172
Oxide of iron and alumina	3·8	3·4	—
Phosphoric acid	10·4	10·7	0·412
Sulphuric acid	1·6	5·4	0·096
Chlorine	0·1	0·4	traces
Carbonic acid	20·3	12·4	0·250
Sand and little silica	10·9	15·3	0·006
Loss	1·3	2·2	—
Totals	100·0	100·0	1·870

The canes had yielded 2·44 per cent. of ash, and the murk, air-dry, 6·65 ; 1 litre of wine had given 1·870 grammes of ash, or 0·19 per cent. ; the density of the wine assumed as 0·960. It is clear that the ash of the canes contains less potash and more lime than that of the murk, and that the proportion of potash to lime is highest in the ash of the wine. Thus we have per cent. of potash contained in ash of canes 18·0, murk 36·9, wine 45·0; per cent. of lime contained in ash of canes 27·3, murk 10·7, wine 4·9. But the relations of magnesia in those parts are different from those of potash and lime, for the percentage of magnesia contained in ash of canes is 6·1, murk 2·2, wine 9·2. The wine yields a very small percentage of ash compared to the other parts, and in consequence its percentage of alkalies is smaller than that of any other part of the vine; but as it has lost much mineral matter during fermentation, the quantity of its ash is not the measure of the quantity of mineral matter removed by it from the soil: for this determination, the murk, before fermentation, has to be examined.

It is of interest to ascertain the amount of mineral matter which a fruit-bearing branch of one summer's growth contains. Berthier analysed such a branch, cut from a Gamay vine at Nemours, in October 1850, at the time of the vintage. Cane and leaves were examined together, but separately from the grapes.

The dry branch and leaves weighed	450	grammes.
The grapes weighed . . .	70	,,

The branch yielded ash consisting of—

Alkaline salts,	6·20	grammes,	or 1·38 per cent.
Earthy salts	20·30	,,	or 4·52 ,,
Total ash	26·50	,,	or 5·90 ,,

The grapes yielded ash containing—

Alkaline salts .	1·56	grammes,	or 2·25 per cent.
Earthy salts .	1·40	,,	or 1·95 ,,
Total ash .	2·96	,,	or 4·20 ,,

The branch and leaves therefore contained 9 times as much inorganic matter, 4 times as much alkaline salts, 14 times as much earthy salts, and 6 to 7 times as much phosphates as the grapes.

The raisin stones contain about 2 per cent. of ash, and of this quantity one-half is phosphate of calcium.

The leaves in full vegetation contain about 75 per cent. of water, and 2·1 per cent. of ash; therefore ash in the dry residue 8·4 per cent. Of this ash one-half is carbonate of calcium, or 51 per cent., and 15·3 per cent. is phosphate of calcium. The soluble potassium salts, obtained as sulphate and carbonate, amount to 15 per cent. of the ash.

Leaves at the time of the fall contain only 66 per cent. of moisture, and 11·34 per cent. of ash, or about 34·02 per cent. of the dry residue. In this ash the carbonate of calcium is increased to 62·62 per cent., the phosphate decreased to 13·27 per cent., and soluble potassium salts diminished to 8·82 per cent. of the ash. The relations of the ash and its soluble constituents in the entire branch to the quantities contained in living and dead leaves are well shown by the following table of Berthier:—

Organ.	Ash in 100 parts, dry.	Amount of alkaline salts.	Amount of earthy salts.
Branch with leaves	5·9	1·38	4·52
Living leaves	8·4	1·26	7·14
Dead leaves	11·34	1·00	10·34

Therefore, as the vegetating organs get older the absolute amount of their ash increases; but this increase consists in the accession of earthy salts only, while the amount of alkaline salts is actually diminishing.

To be complete, we must now study the mineral matters of ripe grapes, and of must. 100 parts of chasselas, grown near Paris, were found by Berthier to contain—

		In these ash
Stalks	4·2	0·06 or 1·431 per cent.
Murk	22·0	0·11 or 0·500 ,,
Filtered juice	73·8	0·194 or 0·263 ,,

These specimens of ash had the following composition :—

	Stalks.	Murk.	Juice.
Alkali salts	0·020	0·060	0·100
Calcium phosphate	0·014	0·030	0·047
Do. carbonate	0·026	0·012	0·035
Magnesium do.	—	0·008	0·012
Totals	0·060	0·110	0·194

Consequently the 100 parts of the bunch of grapes contained—

Alkali salts	0·180
Calcium phosphate	0·091
Do. carbonate	0·073
Magnesium do.	0·020
Total	0·364

100 parts of "pinot noir" (Burgundy grape) contained—

		In these ash
Stalks	3·6	0·060 or 1·7 per cent.
Murk	24·0	0·110 or 4·6 ,,
Filtered juice	72·4	0·298 or 0·40 ,,

The ash in each part had the following composition :—

	Stalks.	Murk.	Juice.
Alkali salts	0·020	0·06	0·154
Calcium phosphate	0·014	0·03	0·072
Do. and magnesium carbonate	0·026	0·02	0·072
Totals	0·060	0·11	0·298

Consequently the entire bunch contained in 100 parts—

Alkali salts	0·234
Calcium phosphate	0·116
Do. and magnesium carbonate	0·118
Total	0·468

The quantities of ash found in these analyses of grapes are much smaller than those which we have assumed in the above comparative table after Vergnette. We have no doubt that the smaller figures approach the quantities more commonly met with. Thus Bouchardat examined several specimens of grape-juice, and never found in them more than 0·067 per cent. of potash, and sometimes as little as 0·045 per cent. Crasso found in the juice of a ripe bunch of grapes 0·326 per cent. of ash, and in that of an unripe one 0·371 per cent. He also examined the four varieties of must as to their ash, and found it to have the following composition:—

Matters contained in the Ash.	Must 1. From unripe black grapes.	Must 2. From ripe black grapes.	Must 3. From ripe black grapes.	Must 4. From ripe white grapes.
Potash	66·334	65·043	71·852	62·745
Soda	0·329	0·423	1·205	2·659
Lime	5·204	3·374	3·392	5·111
Magnesia . . .	3·276	4·736	3·971	3·956
Iron oxide . . .	0·729	0·427	0·091	0·403
Manganese oxide .	0·820	0·747	0·098	0·305
Sulphuric acid . .	5·194	5·544	3·654	4·895
Chlorine	0·745	1·029	0·474	0·700
Silica	1·991	2·099	1·190	2·182
Phosphoric acid .	15·378	16·578	14·073	17·044
	100·000	100·000	100·000	100·000
Density at 16° C. .	1·060	1·085	1·080	1·065

The must Nos. 1, 2, and 3 were from the small variety of the Burgundy grape, or pinot; the must No. 4 came from grapes of the Sylvaner. In the latter occur the maximum of soda and the minimum of potash observed in the series. The quantity of potash in the ash of the juice amounts to about two-thirds of the weight of the entire ash. In the stones of the grapes from which these specimens of juice were obtained no soda at all was met with. Phosphoric acid, amounting to about 16 per cent. in the ash of the must, was found in the ash of the stones to amount to a mean of 24 per cent. Manganese is present in all parts of the vine, and in particularly large quantity in black grapes; such grapes when grown in soil deficient in manganese become less deeply coloured.

There is no particular difference observable between the ash of unripe and ripe grapes. But there is a distinct difference observable in the proportion of the several ingredients of the ash of different species of vine, Thus Walz found in the ash of two Traminer vines, the one grown at Deidesheim, the other at Speyer, the mean of 13·65 per cent. of calcium-phosphate; while two Riessling vines from the same places yielded the mean of 26·25 per cent. of calcium phosphate, and two Ruländer vines (grey variety of Pineau) gave the mean of 26 per cent. of the same bone-earth. The ash of the Traminer vines contained, however, about 10 per cent. more of potash—namely, 38·75 per cent.—than that of the other vines, which in the mean contained only 28 per cent. of this base.

INFLUENCE OF THE SOIL ON THE MINERAL CONSTITUENTS OF THE VINE.

In his analyses of the ash of several varieties of vine grown near Gratz in Styria, Hruschauer found that they all contained the same qualities of ingredients, but in different proportions, which seemed to be determined by the soil on which the vine grew. The pure bases and acids actually obtained in his analyses have been arranged in the following table :—

Ingredients of the Ash.	Quartz soil on Middle Tertiary Formation.	Chalky soil on Devonian Formation.	Micaceous Schist.
Potash	34·13	24·93	26·41
Soda	7·59	7·00	8·57
Lime	30·28	35·94	31·78
Magnesia	4·66	7·12	9·16
Iron oxide	0·16	0·24	0·19
Calcium sulphate	4·55	4·02	4·13
Phosphoric acid	16·35	19·55	16·87
Silica	1·45	0·62	2·48
Sodium chloride	0·83	0·58	0·41
	100·00	100·00	100·00

On calculating the quantity of oxygen in the bases it is found to amount in No. 1 to 17·99 per cent. ; No. 2, to 18·81 per cent. ; No. 3, to 19·05 per cent.

These quantities of oxygen are practically equal to each other. But the quantities of metals in the bases differ considerably, particularly in potash, and magnesia, and lime. A consideration of the law of equivalents shows that each vine required in its ash as much base, or saturating power for acid, as the other, but it used for that purpose different kinds of base—No. 1 taking more potash and less lime; No. 2 less potash and more lime; No. 3 quantities of lime and potash intermediate between the other two. Now, as the proportions between these bases found in the vine were also found in the soil on which they grew, we have here, to this extent, a proof of the dependence of the vine upon the soil in which it is located. When the vine cannot find a particular kind of base which it ordinarily wants for its development, it takes another instead; it does not take a random and uncertain quantity, but substitutes for the one which it cannot have *a chemical equivalent* of that which happens to be available, and by this means accomplishes the cycle of its functions.

Levi established the same fact regarding a vine from the vineyard of Liebfrauen at Worms, and one from Weinsheim. He found in—

Matters.	Liebfrauen Vine.	Weinsheim Vine.
Potash	17·547	25·314
Soda	26·762	2·139
Lime	28·902	38·823
Magnesia	9·173	7·483
Iron oxide	0·392	—
Iron phosphate	9·130	3·623
Phosphoric acid	—	16·813
Calcium sulphate	3·439	4·936
Sodium chloride	4·048	0·869
Silica	1·607	—
	100·000	100·000

In these data the quantities of oxygen contained in the bases are 21·48 and 19·21. The coincidence of the diminution of potash and lime, and the increase of soda in the Liebfrauen vine, is remarkable. If the analyses of Boussingault and Crasso given above are subjected to a similar calculation, it is found that the oxygen in the bases amounts, in the analysis of Crasso, to 18·71; in that of Boussingault to 19·25. These figures approach each other so closely that we are entitled to consider them as the expression of *a law* *of nature*, according to which *the ashes of the vine may contain very variable quantities of potash, soda, lime, and magnesia; but the sum of the oxygen contained in these bases is always the same, or at all events undergoes but slight variations, showing that the substitution of one base for another takes place in equivalent proportions.*

The ash of the vine is obtained by the combustion of its parts; during this process the organic matters, with which the bases or salts were in combination, are destroyed. Instead of malates, tartrates, and tannates, we obtain in the ash carbonates of potash, soda, and lime; and the carbonate of the latter again yields its acid in high temperatures, and appears as caustic lime.

To understand the part which the bases take in the organic life of the vine, we must therefore consider them in their combinations, such as they occur in the natural tissues and juices. In these their main function may shortly be stated to be the fixing and neutralization of acid nuclei, which, under the reducing influence of light, and in the presence of the elements of vegetable nutrition, water, carbonic acid, and ammonia (from which these nuclei themselves have just been formed), are gradually developed to more complex bodies. If these bases are not present in the soil in an accessible form, the vine cannot grow at all; if they are present in insufficient amount, the growth of the vine is stunted, and its fertility is impaired or suppressed; if they are present in the soil in false proportions, the vine effects a substitution, and is able to accomplish the cycle of its changes. But it must not be supposed that this necessity does not affect its growth, durability, fertility, and the nature of its product; on the contrary, it is very probable that a large amount of failure in viticulture is engendered by such a disproportion in the necessary mineral constituents of the soil. Lastly, in soils where the vine finds all the mineral ingredients in proper proportion and quantity, it grows and bears with the greatest perfection. In this argument it is implied that the position, exposure, watering, and mechanical conditions of the soil are equal (in every case), and that the sole variation refers to the mineral ingredients.

AMOUNT OF MINERAL MATTER WHICH VITICULTURE ABSTRACTS FROM THE SOIL.

Boussingault has calculated the weight of matters which were removed from his vineyard (Schmalzberg, near Lampertsloch, Alsatia, Bas-Rhin, an enclosed property of 170 acres' surface) in the shape of canes, murk, and wine.

In 1848 he obtained from this vineyard 55·05 hectolitres of wine. The murk weighed, air-dry, 492 kilos.; 100 parts of this murk left 6·65 of ash, say 32·72 kilos. for 492 kilos.

The cutting of the vines in the spring of 1849 yielded 2,624 kilos. of canes or rods (in 1850 the same quantity within 100 kilos.); 100 parts of rods, burned in the state in which they had been weighed, gave 2·44 parts of ash, say 64·03 kilos. for the entire quantity of wood. Several kilogrammes of ash were actually produced.

A litre of wine left 1·870 grammes of very white ash. The particulars of the analyses of these specimens of ash we have already related above. On referring the several quantities of ingredients obtained to the whole of the vineyard, it is found that in wood, murk, and wine the following quantities of mineral matters are annually exported:—

	Potash.	Soda.	Lime.	Magnesia.	Phosphoric acid.	Sulphuric acid.
In the canes . .	11·53	0·13	17·48	3·91	6·66	1·02
In the murk . .	12·07	0·13	3·50	0·72	3·50	1·77
In the wine . .	4·64	0·00	0·51	0·95	2·27	0·53
Totals	28·24	0·26	21·49	5·58	12·43	3·32

Calculated for an hectare, this gives a total annual exportation of—

	Kilos.		Kilos.
Potash	16·42	Magnesia	3·24
Soda	0·15	Phosphoric acid . .	7·28
Lime	12·49	Sulphuric acid . . .	1·93

Now, whereas from an hectare there is removed by a crop of potatoes 63 kilos. alkalies, 14 kilos. phosphoric acid, of beetroot 90 and 12, of wheat with straw 27 and 19, it is clear that viticulture abstracts much less mineral matter from the soil than root or cereal crops, and that, therefore, the vine can still be cultivated on land on which the other crops would no longer yield remunerative harvests.

It is of course different if during the progress of viticulture green branches with leaves are removed from the vineyards, as is not rarely done in viticultural districts for the purpose of feeding domestic herbivorous animals. In these cases greater quantities of mineral matters are exported, and have to be entered into the calculation.

Vergnette calculates that on the Côted' Or an hectare of land supports about 25,700 vines; these produce annually about 11,462 kilos. of wood, leaves, and grapes, which, burned together, would leave 356 kilos. of ash, containing 69·40 kilos. of soluble and 286·60 kilos. of insoluble salts. If we deduct the leaves, and with them a large percentage of ash, including more than half the soluble salts, we come to figures approaching those of Boussingault.

ORGANIC INGREDIENTS AND CHEMICAL DEVELOPMENT OF THE VINE.

The seed of the vine contains within itself all organic and inorganic compounds, which, with the aid of water, air, and warmth, are capable of producing a young plant consisting of a root with fibrils and spongioles, and a little stalk with leaves. These ingredients of the seed are *lignine*, which builds up its woody structures, then *starch, tannic acid, fatty oil*, several *albuminous substances*, and the *mineral salts* already referred to, in which *phosphoric acid* and *potash* predominate. As soon as by the aid of these materials the organs of assimilation and excretion have been constructed, the young plant becomes independent of the nourishment of the seed, which is indeed exhausted, and draws its supplies from earth and air. These materials are all of an inorganic nature, and are the following:—

Carbonic acid gas.—This is taken up by the roots in solution in water, and by the leaves as gas from the air. It is the material from which the vine forms all its carbonaceous constituents.

Ammonia.—This body is mainly taken up by the roots from the soil, in which it is always present, owing to its being a normal constituent of rain-water. It is the material from which the vine forms all its nitrogenized ingredients.

Water.—This is not only the carrier of all materials which enter the roots in solution, but is also the source of much of the hydrogen contained in the nitrogenized products, and the source of all the hydrogen contained in the products free from nitrogen.

In addition to these, the roots absorb the salts which we have considered in the former section. As soon as a sufficient supply of all these has collected in the cells and vessels of the vegetable tissue, the specific process of vegetable growth begins. This consists in the elimination of oxygen from the carbonic acid, and the combination with the more carbonized product of the elements of water. Thereby a series of acids are formed, which from the beginning are combined with the bases of the mineral ingredients, notably potash and lime. In this manner carbonic acid is first transformed into oxalic acid : this in the vine does not persist, as it does in many other plants, such as rhubarb, sorrel, and spinach ; but by the combination of two of its particles, and the substitution of some oxygen by hydrogen, malic acid, the acid contained in apples and unripe grapes, is formed. This malic acid, by a small addition of oxygen, is easily transformed into tartaric acid, or, inversely, tartaric acid passes into malic by the loss of oxygen. Tartaric acid again, by the union of three of its particles, and the addition of hydrogen from decomposed water, may easily be transformed into grape-sugar, or similar hydro-carbons, just as inversely tartaric acid can be obtained by the breaking up under the influence of oxidizing agents of hydro-carbons, such as lactose, or sugar of milk. It is probable that all the hydro-carbons, *grape-sugar*, *cellulose*, *cane-sugar*, *gum*, and *starch*, which differ from each other very little in chemical composition, and can mostly be transformed the one into the other, are thus produced by the combination of simple chemical compounds and the elimination of oxygen. This process of reduction, as it is chemically termed, in contradistinction to the process in animals, which consists mainly in the addition of oxygen to complex bodies, and their consequent breaking up into simple ones, the process of oxidation, is effected by the vegetable cells, particularly of the leaves, under the influence of the rays of the sun; and it is certain that the green colouring matter or chlorophyll, and a yellow ingredient, luteine, have an important mediating share in these processes. These transformations are most active during the time at which the sun's rays have the highest chemical power, *i.e.* when it stands in the meridian and its rays are most nearly vertical; it is then that the greatest amount of oxygen is exhaled by the leaves, and the greatest amount of nutritive products elaborated within their cells and vessels. The ammonia, in its turn, furnishes the nitrogenized ingredients of the vine, as of plants in general. We know less of the various stages of its metamorphosis and combination in the vine than in other plants. But it is certain that its hydrogen is substituted variously, by methyl, for example, and that it then occurs as tri-methylamine in wine. It probably enters into combination with carbonaceous products in such a manner as to surrender its character as a strong alkali; the less complicated products may still retain the characters of feeble alkalies (alkaloids), but the higher products, the albuminous bodies, are either neutral or feebly acid. The presence of ammonia in the elementary juice of the vine, the sap, has been proved by direct experiment.

When in this manner a plant has been formed from a seed (or in any of the various ways to be described later), it is not at once, and in the same year, able to reproduce fruit and seed. Three entire seasons are mostly required for the development of the roots and wood of the plant to such a size as to enable it to produce a ripe fruit. During these various stages the following chemical compounds are met with in the various parts and juices of the plant:—

The Sap.—The first fluid which rises in the canes at the beginning of the spring is called sap. It is effused from any cut surface which is made upon any part of the vine, and from the terminal cut surfaces of canes it sometimes runs in drops in quick succession, like tears from the eyes of man. The French and Germans therefore term it "tears," and the act of its effusion the "weeping" of the vine. This fluid remains clear on boiling, and does not pass into fermentation either by itself or after sugar has been dissolved in it. A litre of it evaporated leaves about 2·5 grms. of residue. This contains a little acid potassium tartrate, and perhaps gum and soluble starch; altogether, the organic ingredients amount to about 1·9 grm. The remaining 0·6 grm. are inorganic and form an alkaline ash, containing lime, potash, and a trace of phosphoric acid. When the sap is evaporated after a few drops of hydrochloric acid have been added to it, a colourless deliquescent residue is obtained, which, on addition of caustic lime, immediately evolves ammonia. Probably it does not contain any albuminous matters. The sap therefore is a very elementary material, containing only matter necessary for the formation of the first shoots.

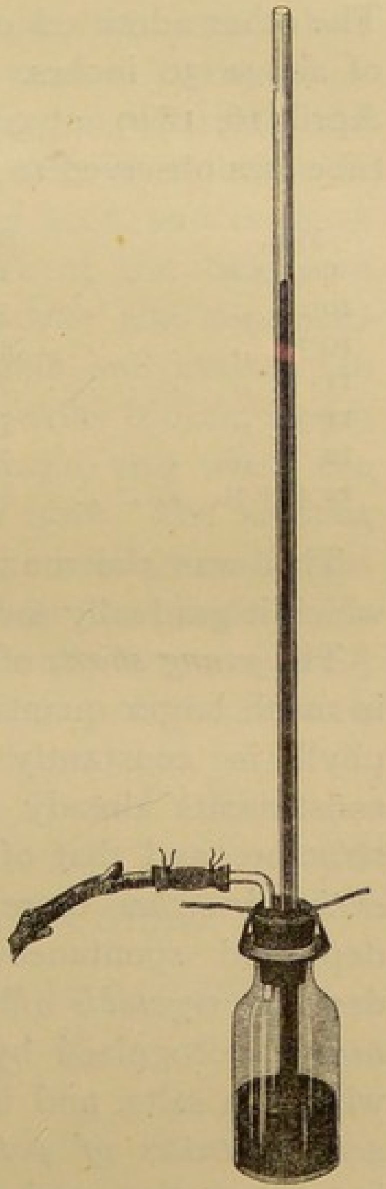


FIG. 8.—Apparatus for measuring the pressure of the rising sap.

The rising of the sap in the cane takes place with an enormous force. This was first measured by Stephen Hales more than a century ago. He fixed a bent glass tube to the cut-off end of a vine-cane, and observed that the effused sap rose in the tube to the height of 21 feet. On filling the glass tube with mercury he observed that this was pressed up to the height of 22 inches. In April 1849 this experiment was repeated by Mohr, upon the canes of a Chasselas or Gutedel. He at first fixed glass tubes to the ends of the canes, but could not carry them sufficiently high up in the air to prevent the sap from overflowing. He thereupon used the little apparatus figured in the engraving (Fig. 8), a glass bottle containing mercury and water, and closed with a cork, through which two tubes passed. With one, bent at right angles, the bleeding end of the vine-cane was connected by caoutchouc tubing. The other admitted of the rising of the mercury to a height of above 30 inches. The apparatus having been fixed on April 16, 1849, at 9.30 A.M., the rise of the mercury in the tube was observed to take place as follows :—

Time.	Height of Hg.	Time.	Height of Hg.
9·45 A.M.	1 inch.	2·9 P.M.	11 inches.
10·10 ,, ...	$3\frac{10}{12}$ inches.	3·47 ,, ...	12 ,,
10·30 ,, ...	$4\frac{10}{12}$,,	7 ,, ...	13 ,,
11 ,, ...	7 ,,	9·45 ,, ...	15 ,,
11·30 ,, ...	$7\frac{4}{12}$,,	On April 17,	
12 ,, ...	$7\frac{6}{12}$,,	8·15 A.M.	$19\frac{3}{12}$,,
12·43 P.M.	$8\frac{7}{12}$,,		

This was the maximum reached by the mercury, after which it gradually sank again to a lower level.

The *young shoots* of the vine contain acid tartrate of potash in much larger quantity than the sap. Cellulose and chlorophyll in constantly increasing quantity, and the mineral constituents already mentioned, are deposited within their structure, and that of the leaves. In the expressed juice of *entire branches* there are found *vegetable fibrin*, which is deposited spontaneously with the *chlorophyll* as a green deposit; *vegetable albumen*, which is precipitated by boiling; *tannin*, recognized by its astringent taste, its inky reaction with iron salts, and its precipitate with solution of gelatine; *acid tartrates of potash and lime*, which can be obtained by evaporation and crystallization; *starch*, recognizable by its assuming a blue colour with iodine; *gum*, precipitated by alcohol; mineral *salts*. The part remaining insoluble consists mainly of *lignine* or *cellulose;* of this substance all wood, old and young, is composed. In the cell-cavities of the wood there is deposited in autumn a quantity of *starch*. When such ripe wood is rasped and boiled with water, the starch is extracted and gives the blue coloration with iodine solution. The *tendrils* contain malates and tartrates and little *tannin*, and have a taste of unripe fruit. The *grapes* contain in their unripe state *malates* and *tartrates*, mainly of potassium, which vary in proportion according to the period of development. Before the appearance of any sugar malates prevail; when the grapes become sugary tartrates prevail, which in the fully ripe grapes maintain their preponderance. The grapes then also contain fibrin, albumen, gum, pectin, tannin, and in largest quantity the sugar peculiar to fruit; the tannin is not in solution in the juice, but deposited in the husk and seed, and requires maceration for its extraction. The husk of the blue and black grapes contains the *blue colouring matter* also deposited in the insoluble state along with the tannin, and extractable only by alcohol and acid, or wine. The stalks contain starch during summer, but lose it towards autumn, and when the grapes are ripe they contain *tannin and acid*. The amount of acid in the grapes increases during their growth, and decreases again during ripening. When the juice from grapes of various periods of growth simply is considered, without reference to the number and weight of the berries, it is observed to become steadily less and less acid, as shown by the following experiments:—

Juice of Blue Tyrol (Black Hambro') Grapes.

On August	15, 1858, quite unripe .	contained	31	per mille acid.
On ,,	30, 1858, unripe, green .	,,	31·5	,,
On Sept.	11, 1858, little coloured .	,,	28	,,
On Oct.	23, 1858, ripe . . .	,,	13	,,
On Nov.	4, 1858, ,, . . .	,,	13	,,

Juice of Blue Burgundy (Pineau) Grapes.

On August	15, 1858, quite unripe .	contained	34·5	per mille acid.
On ,,	30, 1858, ,, .	,,	34	,,
On Sept.	11, 1858, half green, half blue	,,	17·5	,,
On Oct.	15, 1858, ripe . . .	,,	12	,,
On ,,	23, 1858, ,, . . .	,,	9	,,
On Nov.	4, 1858, ,, . . .	,,	9	,,

Juice of White Chasselas (Royal Muscadine) or Gutedel.

On August	15, 1858, quite unripe .	contained	34	per mille acid.
On ,,	30, 1858, ripening . .	,,	15	,,
On Sept.	11, 1858, eatable, not quite ripe	,,	11·5	,,
On Oct.	15, 1858, quite ripe . .	,,	6	,,
On ,,	23, 1858, ,, . .	,,	6	,,
On Nov.	4, 1858, ,, . .	,,	7·5	,,

In the foregoing analyses the acidity is expressed as free tartaric acid, contained in 1,000 parts of juice. In the black grapes the permillage of acidity did not diminish or undergo any change in the time between October 23 and November 4, while in the white Chasselas it experienced an increase during that period. We shall have to consider the question of the changes of the acidity of grapes during ripening more in detail in the following pages.

The proportion of juice to murk has been found in various grapes as follows :—

White Chasselas grapes, stalks removed, gave by strong pressure—juice 97 per cent.; murk of husks and kernels 3 per cent.

Black Pineau grapes, stalks removed, gave—juice 94·8 per cent.; murk 5·2 per cent.

Black Pineau, pressed with stalks, as in the Champagne, gave—juice 91·8 per cent.; murk (including stalks) 9 per cent.

Black Pineau, which had been allowed to ferment with husks and stalks, as in the preparation of Burgundy wine, and then pressed, gave—wine 69·6 per cent.; murk 30·4 per cent.

In this latter case the proportion of the murk is increased by the absorption of much wine, which cannot be removed by pressure.

SPECIAL INVESTIGATION OF THE RELATION OF ACID AND SUGAR IN GRAPES DURING RIPENING.

The percentage of free acid present in grape-juice diminishes with the increasing ripeness of the grape, while the percentage of sugar increases at the same time considerably. From this it has frequently been inferred, that, in the process of ripening, the acid is transformed into sugar. On closer consideration it will, however, appear that such a conclusion cannot be safely drawn from the mere fact of the diminished percentage of free acid, as the weight of the fruit augments considerably during the progress of growth, and thus the total amount of free acid present in the ripe grape may be actually greater than in the unripe fruit, and yet its proportion per cent. be considerably diminished. Moreover, the free acid is not by any means a measure of the total amount of acid present, as there is always some acid united to an alkali, and a greater proportion of alkali in the ripe fruit would account for a diminution of the free acid, even without any increase in the weight of the fruit. We have therefore instituted the following experiments.

The grapes to be experimented on were selected so as to correspond, as far as possible, to average samples in the same state of growth. The berries were then detached from the stalks, as close as possible to the berry, and the weight of one hundred of them carefully taken. They were then mashed in a mortar, and the free acid and sugar estimated, either in the total mash, or in the juice of the mash only. In some cases the combined acid was determined, by estimating the amount of carbonate of potash present in the ash of the juice. The amount of tartaric acid was determined in some cases. The following tables show, first, the amount of acid, sugar, &c. per cent.; and, secondly, the amounts as contained in one hundred berries.

Riessling Grapes, from Rauenthal.

FIRST SAMPLE, TAKEN SEPT. 13, 1866.

Weight of 100 berries, 107·60 grms., consisting of—

Skins	11·49 grms.
Kernels	7·95 ,,
Juice	88·16 ,,
	107·60 ,,

	100 parts of juice contained	The juice of 100 berries contained
Acid, calculated as free T [1]	2·821 per cent.	2·482 grms.
Combined	0·050 ,,	0·043 ,,
	2·871 ,,	2·525 ,,
Sugar	2·98 ,,	2·630 ,,
Ash	2·60 ,,	0·229 ,,

[1] The symbol T stands for tartaric acid.

SECOND SAMPLE, TAKEN OCTOBER 12, 1866.

Weight of 100 berries, 138·5 grms., consisting of—

Skins	14·95 grms.
Kernels	8·74 ,,
Juice	114·81 ,,
	138·50 ,,

	100 parts of juice contained	The juice of 100 berries contained
Acid, calculated as free $\bar{T}$	1·493 per cent.	1·722 grms.
Combined	0·220 ,,	0·245 ,,
	1·713 ,,	1·967 ,,
Sugar	12·10 ,,	13·80 ,,
Ash	0·225 ,,	0·293 ,,

THIRD SAMPLE, TAKEN NOVEMBER 16, 1866.

Weight of 100 berries, 145·6 grms., consisting of—

Skins	14·20 grms.
Kernels	9·07 ,,
Juice	122·33 ,,
	145·60 ,,

	100 parts of juice contained	The juice of 100 berries contained
Acid, calculated as free $\bar{T}$	1·333 per cent.	1·651 grms.
Combined	0·196 ,,	0·236 ,,
	1·529 ,,	1·887 ,,
Sugar	16·20 ,,	19·80 ,,
Ash	0·274 ,,	0·335 ,,

Therefore the free and combined acids, calculated as tartaric acid, amount to—

	In 100 parts of juice.	In juice of 100 berries.
First sample	2·871 per cent.	2·525 grms.
Second sample	1·713 ,,	1·967 ,,
Third sample	1·529 ,,	1·887 ,,

Of these total acids, the real tartaric acid amounted to—

	In 100 parts of juice.	In juice of 100 berries.
First sample	0·175 per cent.	0·154 grms.
Second sample	0·141 ,,	0·162 ,,
Third sample	0·136 ,,	0·168 ,,

The next three samples of the Gutedel grape were taken from a garden at Darmstadt on the 17th of September, 1864.

They were all taken on the same day, from the same wall, and represented different stages of ripeness. The skins and kernels were not extracted from the mash, which was analysed entire. The combined acid was not determined.

FIRST SAMPLE, QUITE UNRIPE.

Weight of 100 berries, 106·50 grms., containing—

	In 100 parts.	In 100 berries.
Sugar	None.	None.
Free acid, calculated as $\bar{T}$.	2·362 per cent.	2·504 grms.

SECOND SAMPLE, HALF RIPE.

Weight of 100 berries, 136·25 grms., containing—

	In 100 parts.	In 100 berries.
Sugar	5·76 per cent.	6·488 grms.
Free acid, calculated as $\bar{T}$.	1·582 ,,	2·155 ,,

THIRD SAMPLE, NEARLY RIPE.

Weight of 100 berries, 279·39 grms., containing—

	In 100 parts.	In 100 berries.
Sugar	8·87 per cent.	24·782 grms.
Free acid, calculated as $\bar{T}$.	0·877 ,,	2·450 ,,

In this, as in the former case, there is a great decrease in the percentage of free acid, but the amount of it present in 100 berries is almost the same in the three samples.

Two samples of Muscatel grape, taken from a garden wall at Dirmstein, on the 4th of October, 1866 :—

FIRST SAMPLE, LESS RIPE.

Weight of 100 berries, 203 grms., containing—

	In 100 parts.	In 100 berries.
Sugar	10·5 per cent.	21·315 grms.
Free acid, calculated as $\bar{T}$.	1·255 ,,	2·547 ,,

SECOND SAMPLE, SOMEWHAT MORE RIPE.

Weight of 100 berries, 307 grms., containing—

	In 100 parts.	In 100 berries.
Sugar	15·40 per cent.	47·278 grms.
Free acid, calculated as $\bar{T}$.	1·010 ,,	3·100 ,,

In this last sample the amount of free acid in 100 berries has actually increased perceptibly, although the percentage, as in all the former samples, has diminished. If we take it for granted that, in the case of the Gutedel and Muscatel grapes, the amount of combined acid increases with the increasing ripeness, then the total amount of acid present in 100 berries would show a decided increase with the increasing ripeness, instead of a diminution, as has been assumed. While, in the case of the Riessling grape, we have an increase of sugar from 2·63 grms. on 13th September, to 13·8 grms. on 12th October; the total acid shows a diminution from 2·525 grms. to 1·967 grms. Then, on 16th November, the sugar has risen to 19·8 grms., while the acid has sunk only to 1·887 grms., thus having in fact almost remained stationary.

The case of the Gutedel is even more striking, for there we have an augmentation of sugar from 0·0 in the first sample, to 24·782 grms. in the third, the acid at the same time sinking from 2·504 to 2·450 grms. or only ·054 grm. $= \frac{1}{50}$ part.

But although the foregoing analyses do not justify the conclusion that in the process of ripening acid is converted into sugar, such may possibly be the case. We have then to assume that at a certain stage of growth the conversion of acid into sugar begins, and keeps pace with the production of acid in such a manner as to keep the amount of acid present always the same, though the percentage diminishes considerably. On the whole, we are led to the conclusion that the acid, if it has anything to do with the production of sugar, does so by an action similar to that which dilute sulphuric acid exerts in the conversion of starch into sugar. The acid suffers no change in the process, a small quantity being capable of producing a large quantity of sugar.

We have thus shown that there is during ripening but a slight, and frequently no diminution in the total amount of acid present in an entire grape, and that the mere percentage of acid is not an indication of such amount.

PECULIARITY OF RIPENING OF THE GRAPES OF THE "ENFARINÉ." ENGLISH "BLACK CLUSTER."

The "enfariné" or befloured vine is a common vine in the Jura, and more particularly peculiar to the vineyards of Arbois. It is one of the class of vines whose fruit contains most acid and least sugar, and would therefore offer few advantages for cultivation, were it not for the great abundance of its fruit and the inestimable property of its great resistance to the hardships of the mountain climate. It is mostly mixed with the Poulsard, the Trousseau, and the Baclan. If its juice does not exceed $\frac{1}{12}$ of the entire mixture, it is said to be beneficial to the wine.[1] The acidity of the grapes of this vine does not always diminish with its maturity, and the sugar does not always increase.

Experiments made in 1863.[2]

On September 16 some of the very ripest grapes, as ripe indeed as the vine can yield them, were selected.

They yielded in 1,000 parts of juice: total acid, calculated as tartaric, 23·1; sugar, 153·9.

On September 19 three lots of grapes were selected.

1. The ripest grapes chosen from amongst the blackest gave must which yielded: acid, 24·8; sugar, 159·9.

2. Red grapes without any black appearance: acid, 23·4; sugar, 150·0.

3. Grapes, partly red, partly black: acid, 23·4; sugar, 128·9.

Experiments made in 1864.

On September 27 three lots were again selected.

1. The most ripe black grapes: acid, 21·4; sugar, 156·7.

2. Red grapes about to become black: acid, 21·8; sugar, 135·1.

3. Green grapes just beginning to get pink: acid, 21·8; sugar, 135·1.

Vintage of September 28.—Four lots were cut.

1. The blackest grapes in the apparently highest state of maturity gave: acid, 21·4; sugar, 156·7.

2. Grapes of a violet-red colour, with no green: acid, 24·4; sugar, 60·3.

[1] Rendu, Ampelographie française, p. 255.

[2] Pasteur, Maladies du Vin, p. 202; Vitography and Synonyms, see Babo, p. 158.

3. Reddish black and blackish red grapes: acid, 21·8; sugar, 146·4.

4. Quite green grapes, and grapes which began to get red: acid, 25·5; sugar, 79·5.

Vintage of September 30.—Three lots of grapes were selected.

1. Grapes with black surfaces: acid, 18·3; sugar, 167·7.

2. Grapes black at the point, red at the insertion of the stalk: acid, 22·5; sugar, 132·7.

3. Red violet grapes, without black: acid, 24·5; sugar, 102·3.

From the analyses of the vintages of September 19, 1863, and September 27, 1864, it follows that the acidity of the red grapes, and of those which are partly red and partly black, is less than the acidity of the quite black grapes. At a certain moment of maturation, if not during the whole process of ripening, the amount of acid increases therefore, instead of diminishing, as has hitherto been supposed to be the rule for all fruit. Consequently the fact speaks against the assumption that the sugar is a product of transformation of the malic and tartaric acid.

The vintages of September 28 and 30, 1864, do not give the same result. Here the amount of acid decreases somewhat in a certain proportion with the increase of sugar. But they show, with the first analyses, the curious fact that the quantity of acid changes very little, while that of the sugar increases very much.

The second lot of the vintage of September 28, 1864 (red grapes), contained less sugar than the fourth, which was made up of less ripe, namely green, or reddish green grapes. Here a diminution of sugar might be assumed as a result of ripening, as before we have concluded upon an increase of acid. The red grapes No. 2 of the vintage of September 19 had much more sugar than the red grapes No. 2 of September 30. They were a little more advanced, and from another vineyard.

The ripe "enfariné" of 1863 was more acid and less sweet than that of 1864.

PROCESS OF RIPENING OF THE "PLOUSSARD" GRAPES.

This vine is also called Poulsard[1] and Poulsare, and is largely cultivated in the Jura, on account of its strong constitution and the abundance and excellence of its grapes. Its red wine has great *finesse* and an agreeable taste, but it sheds its colour rapidly, when in cask in two or three years, and is very delicate and apt to pass into acetous fermentation.

Experiments made in 1863.[2]

Vintage of September 7.—This was divided into three lots, No. 1 being the ripest black grapes: acid, 8·5; sugar, 195·4.

2. Red grapes, termed "grains lie de vin:" acid, not determined; sugar, 135·7.

3. Green grapes just becoming red: acid, not determined; sugar, 95·5.

The character of the total must which the entire vintage would yield can be judged from the fact that out of 13·495 kilos. of these grapes 9·433 gave must of composition 1; 3·862 gave must of composition 2, and 0·200 gave must of composition 3.

A few very ripe grapes gave must containing: acid, 6·3; sugar, 200·3.

Vintage of September 16.—1. The blackest grapes of the ripest bunches gave: acid, 6·4; sugar, 209·4.

2. Half ripe grapes, or those between red and black: acid, 18·8; sugar, 165.

3. Red grains, called "grains lie de vin," showing neither green nor black: acid, 18·7; sugar, 146·3.

4. Green grains beginning to show a rosy tint: acid, 20·6; sugar, 84·9.

Vintage of September 18.—Ripest grapes of the blackest bunches: acid, 6·4; sugar, 210·5.

[1] Rendu, p. 253. [2] Pasteur, p. 209.

Experiments made in 1864.

Vintage of September 27.—Blackest grapes of ripest bunches: acid, 8·8; sugar, 215·0.

Vintage of September 28.—Blackest grapes from ripest bunches of the best situation, renowned for giving the best wine of Arbois: acid, 8·3; sugar, 221·5.

In the vintage of September 16, 1863, it was omitted to take a sample of merely ripe grapes, like those of No. 1 of September 7. We may assume it to have contained 8 grms. of acid and 200 grms. of sugar per litre.

Nos. 4, 3, and 2 of the vintage of September 16, 1863, show that the process of ripening consisted at that period mainly in this, that the green and red grapes took up sugar. In the riper grapes, however, the process showed itself as a diminution of acid. In passing from 4, green, to 3, red, the grapes lost 2 grms. of acid, and gained more than 60 grms. of sugar per litre of must. On the other hand, the red grapes, during the process of getting partly black, lost only an insignificant amount of acid while gaining nearly 20 grms. of sugar. We see, further, that the grapes already partly black or three-quarters ripe, in passing to perfect maturity, lose much acid, while their sugar does not increase in proportion. For every 10 grms. of acid lost only 35 grms. of sugar are added. And in passing from grapes which have only just become black to those which have already been so during some time, it is found that the sugar increases very little, while the acid diminishes notably. This is particularly seen by comparison of Nos. 1 and 4 of the vintage of September 7, and by comparison of the vintage No. 1 of September 7 with No. 1 of vintage of September 16.

There are therefore two kinds of ripening—one, peculiar to the grape which is not yet black, consisting in an augmentation of sugar; the other, a process mostly accomplished in the black grape, consisting in a diminution of acidity.

The grapes of the Ploussard attain a certain degree of ripeness beyond which they experience no change in the relation of their acid and sugar, however long they hang on the vine. It is, however, possible that they undergo other beneficial alterations as yet unknown.

In the vintage 1864 *the very ripest* grapes of the Ploussard had *more* acid than in that of 1863, although they were taken fifteen and twenty days later than the grapes of 1863. But the Ploussard of 1864 had a little more sugar than that of 1863.

CHAPTER II.

GENERAL PRINCIPLES OF VITICULTURE.

Soil favourable to viticulture.—Manuring and improvement of the soil in vineyards. —Improvement of the soil.—Manuring.—Quantity of dung required by the vine.—Manner of manuring.—Modes of propagating and multiplying the vine. Propagation by seeds.—Propagation by means of eyes.—Propagation by means of cut canes.—Propagation by means of layers. —Multiplication by grafting.—Eye-grafting.—Simple inarching.—Compound inarching.—Grafting in grooves.—Summary of general principles of the cultivation of the vine.

SOIL FAVOURABLE TO VITICULTURE.

THE vine grows on chalky, siliceous, aluminous, and magnesian soil, on granitic mountains, on formations of transition, and on secondary, tertiary, volcanic, and alluvial territories. But in all parts of the world vines grow with predilection along the borders of rivers. The wild vine of the Rhine valley is found on the borders of marshes. The most luxuriant growth of the vine and its richest bearing power are met with in the paludal districts of the Gironde. This shows that while the vine is a most accommodating plant, and will even succeed on poor land, on which almost every other vegetable would perish, yet its most perfect development, and consequently its highest bearing power, and *à fortiori* its most profitable cultivation, are dependent upon certain conditions which are not often found united.

The vine requires for its upper and main roots a territory which must not be clogged with water, but be pervious to it, and admit air at frequent intervals. But at the same time it requires a constant supply of water within easy reach of the roots. It therefore lives best on ground which, although not itself soaked with water, can constantly attract it from the subsoil by means of the capillary attraction due to its porosity.

This is exactly the case in the paludal districts of the Gironde, where the ground-water is within a few feet of the surface. The want of such subsoil water can be supplied by frequent natural or artificial irrigation. The vines of the Médoc are placed upon little hillocks of gravelly soil, and receive rain at frequent intervals from the clouds which come landwards from the Atlantic. The water quickly sinks into the loose ground, and, leaving its manurial ingredients to be absorbed by the spongioles, soon makes way for a supply of fresh atmospheric air.

Soil may be defined as a piece of territory having surface and depth, and the mechanical and chemical conditions for the growth of a plant. The great bulk of all soil serves (with regard to vegetation) mainly the mechanical purpose of holding in a dilute and equally distributed form the chemical materials for the growth of the plant. This bulk is mostly quite unfit to sustain the life of any plant. It may consist of quartzy sand, of pebbles, of chalk, to the extent of from 80 to 90 per cent. It is only the smaller portion completing the 100, which acts chemically by retaining and furnishing to the plant the inorganic materials of growth. This has been experimentally proved by Wiegmann and Polstorf. They cultivated a variety of agricultural plants to the utmost perfection in soil which they had compounded entirely out of known ingredients. These were in 1,000 parts:—

Quartz-sand	861·26
Sulphate of potash	0·34
Common salt	0·13
Gypsum (anhydrous)	1·25
Washed chalk (whiting)	10·00
Carbonate of magnesia	5·00
Oxide of manganese	2·50
Oxide of iron	10·00
Hydrate of alumina	15·00
Phosphate of lime	15·60
Peatate of potash	3·41
,, soda	2·22
,, ammonia	10·29
,, lime	3·07
,, magnesia	1·97
,, iron	3·32
,, alumina	4·64
Insoluble peatic acid	50·00

The peatic acid was extracted from peat, by boiling with dilute caustic potash, and precipitating with sulphuric acid. This acid and its salts were added to supply the ingredient which in fertile soil is termed *humus*. Now such artificial soil will feed to perfection any vine; it can be used to rear vines in earthenware pots, or in tubs, or even to prepare the bed of a vinery. The peat acid and its compounds can be supplied by an increased quantity of peat mixed with the mineral ingredients mentioned. It even appears that peat itself can be made to take the place of the quartz-sand, and can be impregnated with the inorganic food of the plants by infusing upon it the watery solution of the necessary chemical substances (Nägeli and Zöller). Such soil as the foregoing we will term *ideal* or *rational* soil. It is useful for experiments to investigate the natural laws which determine the growth of plants. But it could not easily be prepared as an instrument of agriculture on remunerative terms. It is the ideal standard to which every viticulturist must endeavour to raise the particular soil of his vineyard. Next to this ideal soil we have to consider the *empirical* prepared soil which is capable of producing the best vines and grapes. On this subject our English gardeners have considerable experience. Thomson ("Cultivation of the Grape Vine," 1867, p. 14) says that vines such as are grown in English glass-houses thrive best in a fibry calcareous loam, taken not more than three inches deep, from an old sheep or deer pasture. Such soil should consist of about 65 per cent. of sand, 30 per cent. of clay, and 5 per cent. of chalk, with an abundance of vegetable fibre, giving it the character of what gardeners know as friable turfy loam. When the sand is in excess, it may be called sandy loam; when the clay is in excess, clayey loam. To prepare such soil the turf is cut and thrown with the grass downwards, and allowed to remain so till frosty weather sets in. The lumps are now stacked while in a frozen state, and left for six months so that all the grass is dead. The whole is now well mixed with shovel and fork, and further prepared as follows:—To ten carts of it add two carts full of lime rubbish, preferably old plaster with hair in it; one cart of thoroughly charred wood, including any wood ashes which may be amongst it; one cart of fresh horse droppings; 4 cwt. of broken bones about an inch square, and if possible 2 cwt. of horn shavings. Have the whole mass well mixed by turning it over several times if possible in frosty weather, and it will be ready either for forming of itself the bed of vines grown in glass-houses, so-called vine border, or for being placed as an amelioration or manure upon such beds, or upon land upon which the vine grows in the open air.

Of this empirical soil the English gardener requires from 120 to 150 cubic feet for a single full-grown vine, whereas of the ideal soil not more than 27 cubic feet would be required to obtain the same result. It is probable that, by a combination of chemical manuring with the employment of the artificial compost described, a great saving of material, space, and labour may be effected in English vineries. The compost itself might also be greatly improved, *e.g.* by a greater comminution of the bones, or the employment in their stead of the more soluble superphosphate.

MANURING AND IMPROVEMENT OF THE SOIL IN VINEYARDS.

There are a few varieties of natural soil which will continue to bear fruit for centuries without ever being improved or manured. But these are so exceptional that they cannot be allowed to guide our general treatment of the vine. Most soil produces fruit for a certain period, be it ten or a hundred years, and then ceases to be remunerative. This cessation of the fertility of the soil is due to the abstraction from it of the mineral salts which the plants grown on it take up and retain in seeds, stalks, leaves, wood, and roots, as we have shown in a former paragraph. As these mineral matters are always present in limited quantities, it behoves every proprietor or cultivator of a vineyard to make two classes of observations, and effect two kinds of chemical treatment of his soil. First he should observe the quantity and quality of his produce. From these he judges whether or not his soil is deficient in any mineral ingredients. If it were wanting in potash and phosphoric acid, he would obtain but little growth of fruit; his fruit would be imperfect, ripen badly, and give bad wine. Or if the deficiency of these ingredients was still greater, the fruit would not even set, although there might be a good show of blossoms. The parallel observations might be directed upon the soil, which should be analysed to ascertain whether the quantity of phosphate and potassium salt present was sufficient or not. Clay soil generally would have sufficient potash not to require augmentation. Chalk soil, on the other hand, would probably not have sufficient potash, and require it to be augmented. The second series of observations which he would have to make would be concerning the quantity of mineral matters exported from the vineyard in the grapes, the green branches, or the old wood. With regard to this point we have given above the most reliable data for everybody's guidance. The rule then upon which the proprietor has to act is this: to find, by the scientific process indicated, the amount of mineral matters removed from his vineyard, and to restore to it every year at least as much as he has taken out in the crops. It will be seen that by such a process the natural ability to produce is preserved, but not increased. If, therefore, a vineyard suffered from a want of the constituents necessary for the perfection of the vine, it would not, by the mere restoration of that which was abstracted from it, become more fertile, but in this case the absolute amount contained in the soil would have to be increased by special proceedings.

IMPROVEMENT OF THE SOIL.

Vineyards on calcareous soil are best improved by carrying into them a quantity of siliceous sand. If disintegrated granite can be obtained, it is very useful. On the other hand, siliceous soils are best improved by mixing with them a quantity of clay marl. The viticulturist should take care to find his means of improvement as near as possible to the land on which they are wanted, in order to keep down the expense of carriage. Frequently one of the best means is to dig a deep hole in the vineyard itself, and to find whether the lower strata do not contain what is wanted. In our experience this has been more frequently the case than otherwise. Marl contains potash, chalk contains the lime necessary for the perfection of the grape, and these two adjuncts are most powerful in improving the quality of the wine, so as to give it *finesse.* Earth is frequently carried into the vineyards. It may, of course, be very useful if it be the result of long cultivation, and contain a large amount of decayed vegetable matter—if it be, in fact, in that state which we call *humus.* In some parts of Germany—for example, in Würtemberg—the carrying of earth into the vineyards is a laborious and expensive occupation, carried on every year, frequently without any prospect of advantage. Just as in some parts of the world there remain commons where the poor man can herd his cow or his donkey, so here there are set aside lands from which the viticulturist has a right to fetch his earth ; and not rarely there are disputes and lawsuits about these earth rights. Of course in rocky situations the addition of mould is essential to the maintenance of the vineyard, as one can see in Dalmatia, where the vineyards exist only on earth carried on to the rocks. But we are afraid that on the whole the carrying of earth into vineyards possessing territory is as useless a proceeding as the popular carting of lime and chalk upon ordinary agricultural land has been found to be in Saxony. The vine does not absolutely require humus. It requires a medium in which it can strike its roots, and if in that medium it finds the mineral ingredients, all others are supplied by the atmosphere. We believe the recognition of this truth to be of the utmost importance for the future of viticulture, for in most parts where the vine is extensively cultivated the production of manure by agricultural means is very expensive. On the other hand, the supplying the soil with all necessary mineral ingredients has now become relatively easy since the potash mines of Stassfurt have put potassium within the reach of agriculture, as common salt is within the reach of everybody.

When a soil contains too much clay, it may be heaped up, mixed with small coal and burned, or a certain amount of burnt clay may be mixed with it. Lindley ("Theory and Practice of Horticulture") describes clayey loam soil as so adhesive that air cannot get into it. It also offers great mechanical opposition to the passage of roots through its viscid mass, and hence it is exclusively inhabited by a coarse and worthless vegetation. Burning changes all this; the particles of clay lose their adhesiveness, and this gives a new character to the soil, which offers freedom to the entrance of air and exit of water, and crumbles readily away beneath the advancing roots of any race of plants. There is this further difference between burned and unburned clay, that the roots of plants which it previously contained were unable to decay, and are now by fire reduced to their saline constituents, and so enrich the soil; and moreover the burned particles of clay acquire the power of absorbing ammonia from the air, and holding it within their pores till showers fall and wash it into the land, where it immediately acts as a nourishing food for plants.

All sandy and clayey soils should be carefully supplied with chalk and gypsum. The latter, like the burnt clay, attracts carbonate of ammonia from the air, and is converted into chalk on the one hand, and sulphate of ammonia on the other, both being acceptable food to the vine.

MANURING.

The best manure for the vine is stable manure, by which we mean, of course, the mixture of straw and the solid and fluid excrement of cows and horses or other animals. The value of this manure will stand in a direct proportion to the amount of urinary ingredients which it contains. Mere straw will as little manure a vineyard as the mere excrement of a cow or a horse. Human excreta may also be used for the manuring of the vine; but in all manuring of the vine it has to be considered that ammoniacal ingredients are apt to produce too great a vegetable development of the branches, particularly in the absence of the ingredients necessary for the development of the fruit. Where manures have to be kept for a long time subject to the effects of rain and air, it is well to transform them into composts; that is, to stratify them with thin layers of earth, and to frequently change the construction of heaps so made by resetting them. The manure thereby becomes short, half rotten, and more easily managed. In many parts of France, where the principles of mineral manuring are not understood, parts of various plants are used for the purpose of improving the soil. Thus the people collect broom in the forests, and all kinds of leaves and herbs, and, after sopping them with a little fluid excrement, put them into holes close to the vines. In many parts of Styria viticulturists dig trenches and fill them with fagots cut green. In other parts they grow green crops in the vineyards and dig or plough them under. These proceedings may have a collateral advantage in certain places besides their main object; but whenever such an advantage is not consciously sought for, we are sure these indirect processes of manuring had better be supplanted by the process of mineral manuring.

Quantity of Dung required by the Vine.—If we take a material containing no nutriment whatever, say peat, or chalk, or silica in the form of sand or small granules —a soil in which a vine would not live more than a few months; and if we take of this soil a sufficient quantity to fill a box three decimetres deep and four decimetres square, and then mix with this medium fifty litres of compost containing forty litres of ordinary earth, and ten litres of consumed manure; and if in this mixture we then plant a vine, it will become completely developed in the fourth, fifth, or sixth year, according to climate. If from this period five litres by measure, or two and a half kilos by weight of dung are spread every year around the vine, on the surface of one square metre, dug under, and mixed with the soil, without reference to the original mixture of earth and manure in which the vine has been planted, the vine will be maintained in sufficient strength to produce every year beautiful wood and twenty grapes of at least fifty grammes' weight each. In the eighth year the quantity of manure to be dug under may be diminished by one-fifth. Guyot asserts that in the Champagne, the Landes of Bordeaux, and the sands of the Sologne, the vine will always yield a weight of grapes equal to the weight of dung given to it. In fertile territories, however, where the vine would grow naturally, though imperfectly, half the weight of dung above stated will be sufficient. Supposing there were on an hectare ten thousand vines, and each vine were to produce on an average one kilo of grapes, or eighty hectolitres of wine, of an average value of twenty francs an hectolitre, the gross income of an hectare would be sixteen hundred francs. In an ordinary soil this harvest would have required ten thousand kilos of manure of which each thousand kilos would have cost fifteen francs, giving a total of one hundred and fifty francs. In a bad soil, however, twenty thousand kilos of manure would have been required, at an expense of three hundred francs. In a good soil the dung necessary each year would therefore cost one-tenth of the gross produce; in a bad soil it would cost one-fifth. For a long time the question has been agitated whether the vine could be manured without altering the quality of the produce, and whether manure ought to be put directly into the vineyard, or be first consumed in the manner of compost. This has been answered by experience to the following effect. It is necessary to manure the vine with animal dung directly, and to carry the manure into the vineyards, and to dig it under near the vine after the vintage, and as early as possible before the next period of growth. If the manure is carried to the vineyard in autumn, it has time to become partially oxidized and rotten; its ingredients are spread equally throughout the soil by means of the rains, and therefore become accessible to all the roots of the vine. We know that the soil retains all mineral ingredients wanted for the production of vegetable growth, *absolutely*, and in proportions sufficient for fifteen or twenty successive crops. We know that of ammoniacal manure it retains from twelve to fifteen hundred times the amount necessary for any given crop. Hence manure cannot be carried to the land too early, for no part of that which is beneficial to the vine can be lost. On the other hand, if there be an excess of ammoniacal manure present, an excessive vegetable growth will be produced, and engender the presence in the fruit of an excess of albuminous matter relatively to other constituents. It is this which will give to wines bad qualities affecting their taste and lasting power. Many viticulturists at Argenteuil, near Paris, have for years been in the habit of manuring their vines with the street mud of Paris, and they say that their wine had been deteriorated thereby, so that while at one time it was drunk at the table of the King of France, it is now consumed only in the little public-houses of the *barrières*. Guyot remarks that they forget that since that time they have pulled out every fine vine that was formerly contained in their vineyards, and have everywhere planted the Gamay. Here and there they have left a few plants of the Meslier François, and upon these last Guyot made an interesting experiment. He manured them with the street mud of Paris, and obtained a quality of wine which was worthy of its ancient reputation. No doubt the exhalations of fresh manure, if it is put underneath the ripening grapes, adhere to them and make them detestable. For the rest, it is the general experience, which we do not think can be opposed by any facts to the contrary, that the more and the more carefully a vineyard is manured, the better and more abundant will be the wine which it will produce. Those who would doubt this, we advise to pay a visit to the Johannisberg Castle, and to Steinberg, or, at all events, to peruse the accounts which we have given of the farms of those establishments kept exclusively for the purpose of furnishing manure for those celebrated vineyards.

Manner of Manuring.—To manure every year would, of course, require a great deal of manual labour. To economize this as much as possible, the manure calculated to be required is mostly carried to the vineyard once in three years. In good soil one should give to each vine $1\frac{1}{2}$ kilos, in medium soil 3 kilos, in bad soil 6 kilos of manure, every three years. Every hectare would therefore require in three years either 15,000, 30,000, or 60,000 kilos of manure. If this quantity of manure is compared with that required by cereals, it will be found to be much less, and this is mainly due to the fact that the fruit of the vine removes from the soil much less phosphoric acid than cereals. The manure should be put into the ground at some time during the period from the beginning of November until March—the earlier the better. It should be covered with at least 5 or 6 centimetres of earth. It is particularly in the operation of digging under the manure that cultivation by the plough proves itself useful. The plough leaves a long trench: this trench is filled with the manure, and the plough then goes the reverse way, throws the earth towards the vine, and covers up the manure. If the manure is not covered sufficiently deep with earth, it produces weeds, which either require manual labour, or prevent the effect of the sun from being exerted. Further, the roots of the vine are drawn towards the dung, and, when the plough passes again through that portion of soil in which manure has been buried to an insufficient depth, they become disturbed or destroyed. In some parts of the Graves of Bordeaux we have seen the manure applied in the following manner. A square hole measuring about a foot in every direction was dug round the foot of the vine. This was filled with manure, so that for a distance of about 9 inches the trunk of the vine was surrounded by nothing but manure. The hole was then covered with earth. It will, of course, very much depend upon the quality of the manure used what may be the effect of such treatment. We have, however, seen more than once that good strong stable manure applied in this fashion has impaired the strength of, or altogether destroyed the vine; for the saprophytes or fungi growing in rotting vegetable matter have a great tendency to penetrate into living vegetable matter, and thus they get from the manure into the bark of the vine and destroy it. We therefore do not counsel the practice which we have seen in the Graves, but advise that stable manure, if not transformed into a *con-*

sommé or earth-like compost, should not be put in direct contact with the vine or its roots.

MODES OF PROPAGATING AND MULTIPLYING THE VINE.

Propagation by Seeds.

The propagation of the vine *by seed* is not frequently employed, as it takes five or six years before a seedling begins to bear. It also happens frequently that seedlings do not fulfil the expectations with which they were reared, and have to be torn out. This is, however, not always the case; and if care be taken by the viticulturist to properly impregnate the flower from which he wishes to grow seed, most beautiful and interesting varieties of vines are produced. Among the vines thus produced by crossing of races and growing from seed are several American varieties, *e.g.* Norton's seedling, and the Chasselas Napoléon; the latter is the largest and finest grape which grows in France in the open air. A seedling can be made to bear fruit in the third year by grafting it, in the manner to be hereafter described, upon an old stem. The seed to be sown is taken out of the grapes when they are quite ripe, and kept in a box in a cool place, like any other seed, until spring. It is then sown in fine good earth, either in pots, and in the month of February if the process is carried on in a conservatory or forcing-house, or in the month of March in the open land of a garden. It takes about six weeks before the little plants appear above ground. When they have been grown in pots in hothouses, they may be removed to the open air when they are about 6 inches long, generally in May. In the second year they may be transplanted from the pots into the open land. They are allowed to grow unchecked for two seasons, whereby they acquire much wood and root. In the third year of open culture, the fourth of growth, they are cut the first time and may yield fruit. They come to full bearing in the sixth year.

Propagation by means of Eyes.

Eyes may be cut from vines as represented in the engraving

(Fig. 9), and planted in open beds and vineyards. Such will, in one season, form a small vine with particularly great development of roots, as shown in the next engraving (Fig. 10).

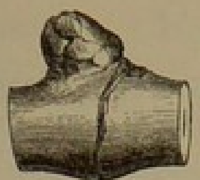


FIG. 9.—Eye ready for planting in open beds in vineyards. (Natural size.)

An improvement on the foregoing is the specifically English method of propagating vines, which when practised in forcing-houses yields in one year a strong vine, capable of bearing twelve bunches of grapes the next year. The eyes to be "struck" are selected from well-ripened wood; the cane is cut right across about half an inch above and below the eye, and then a small slice taken off the side of it, longitudinally opposite the eye: this slice in the practice of some gardeners amounts to half the wood, so that the cut passes through the marrow cavity, in the manner represented by Fig. 11, p. 59.

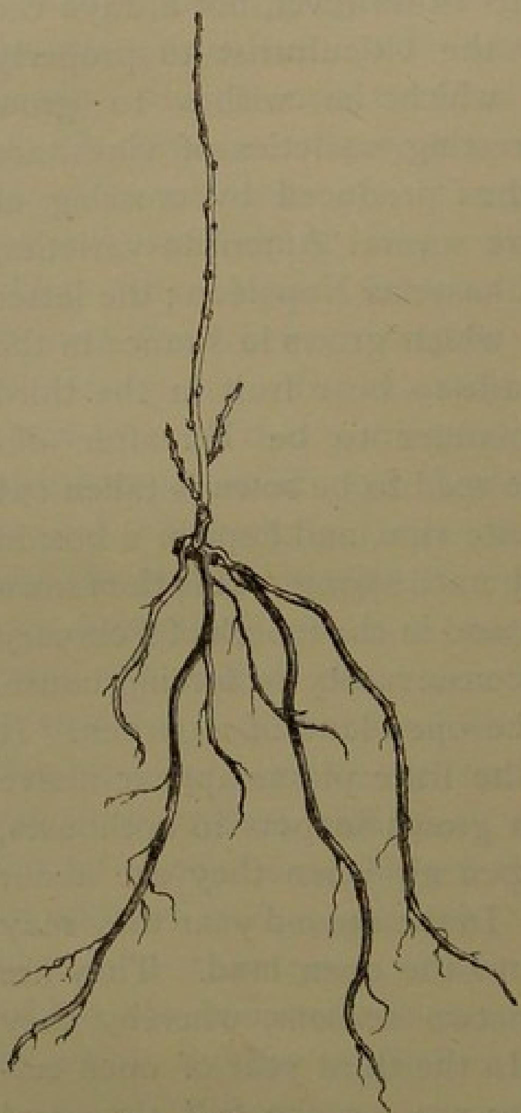


FIG. 10—Young Vine, one summer's growth, from eye planted in open bed in vineyard. (Reduced to one-tenth of natural size.)

The English viticulturists place these eyes in pots filled with light turfy loam and a small portion of thoroughly decayed leaf mould. When the pot is filled with this soil, they make a hole of the size of a walnut in the centre of it, fill it up with fine white sand, and place the eye into this sand so that all the wood is buried and nothing but the eye projects. Some also cover up the eye with a little compost. It is a striking testimony in favour of our ideal soil above described, when Thomson says that cuttings form callus sooner in sand than loam, and throw out more roots also.

When thus potted in January, says Thomson, they may for a time stand in any convenient corner of a peach-house or vinery just started. By the 1st of February they should be plunged in tan, or some other medium affording a bottom heat of 90° F. and placed as near the glass as possible. With an atmospheric temperature of 55° at night, rising to 70° by day, the buds will soon appear above the soil. Cotemporaneously with the development of leaves, roots will be emitted all round the edges of the bud where it starts from the wood. At this stage the plants must be kept well watered, and the bottom heat be moderated by shaking the pots in the tan in which they are embedded. When the plants have four leaves developed, the pots are raised out of the plunging material, and though they will not make such rapid growth as if left in the bottom heat, they will make a much safer one. The pots are soon full of roots, but the plants should not be shifted into larger pots till they have begun to grow afresh after the stand they make when the available energy in the bud is exhausted, and before the young roots and newly developed leaves have begun to supply more. If shifted before this second growth begins, they frequently stand still for a month, and often end in premature ripening at the neck, and refusing to start into a healthy second growth at all. During the most active time of growth they are watered with a well-stirred mixture of water and cow-dung.

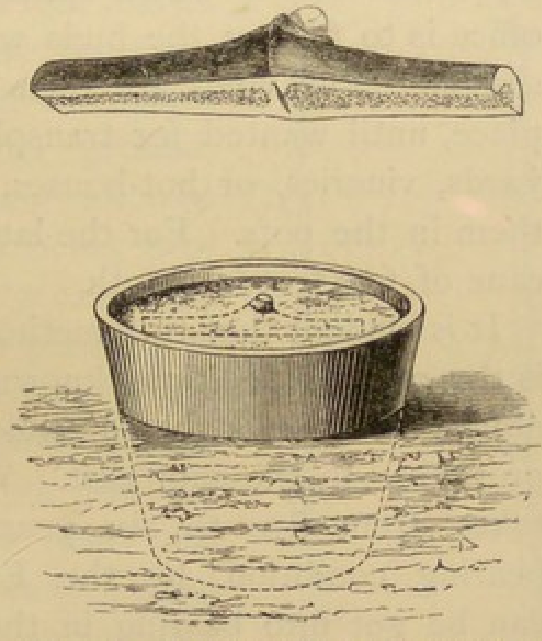


FIG. 11. — Eye and slice of cane ready or being embedded in earth. Pot of earth with the eye embedded, plunged in tan.

If it is intended merely to produce a vine for transplanting, the pots into which the young vines are shifted should be 8 inches in diameter at the top; if, however, it is intended to grow grapes on the vine in the pot the next year, the pot should be 18 inches in diameter. Thomson advises to cut all such forced vines back to one foot, as soon as they are six feet in length, as they will start afresh and make much finer and more fruitful canes than if allowed to grow on; the laterals as they appear should be stopped at one joint. These laterals will break again, and should be pinched so as to leave another joint. When the canes become brown, and all the symptoms of ripening show themselves, the whole of the lateral branches may be cut off, care being taken not to injure the leaves which spring from the main stem, as their office is to fill out the buds which are to produce fruit next season. The vines are then kept in a cool protected airy place, until wanted for transplanting into the open air, vineyards, vineries, or hot-houses, or until it is desired to fruit them in the pots. For the latter purpose they are allowed a cane of five feet in length.

It is evident that this method of obtaining vines from eyes is the most expeditious known, and, as the vines bear in the next year from eight to twelve bunches each, also the most profitable to the capitalist. Whereas, ordinarily, a vineyard takes from five to six years before it can be got into bearing condition, by the English method any vineyard can be got into bearing in the second year. Such a vineyard will therefore bring four harvests, amongst them three full ones, before a vineyard planted with cut canes will bring one, and will thereby not only repay the first outlay on the forcing-houses and the interest of the cost of the land, but also leave a large profit.

Propagation by means of Cut Canes.

The most common, because least troublesome and cheapest, method of multiplying vines is by the planting of *cut canes* (French, *boutures;* German, *Blindholz*). Fig. 12 represents two varieties of such canes,—one a simple piece of a one-year cane about $1\frac{1}{2}$ feet in length, and carrying from 7 to 9 nodes; the other a cane of similar length, but provided with a piece of the previous year's wood from which it has sprung (French, *crossette*). These canes are obtained at the time when the vines are cut, in open viticulture generally in March, but frequently already in autumn. The strongest and healthiest of them are selected, tied in bundles, and buried in a horizontal position, a foot deep in the earth, for a month or two; this is done to arrest their growth until the time of planting arrives. When this has been determined on, say early in May, they are dug out, and placed with their lower end up to one-third of their height in water, until the eyes have swelled to the size of peas. Just before planting, two longitudinal slices of bark four inches long are cut off the sides where there are no eyes at the lower end, and the canes are then immediately put under ground, the uppermost eye alone being allowed to project above ground, and being protected by some sort of short stake from rough mechanical injury. This planting of canes is done with more or less care, and succeeds accordingly. Sometimes a mere hole is bored with an iron rod, and the cane plunged in and trodden firm with the foot. In other cases the cane, placed in the hole made as before, is surrounded with soft earth or sand. Or the canes are planted in ditches, which are then filled up with made soil or compost. This latter method is to be recommended in nurseries for young vines, where the canes come to stand in lines, the lines being a yard and the canes a foot from each other.

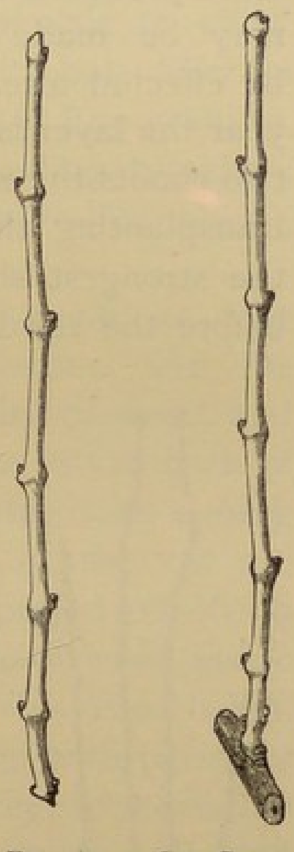


FIG. 12. — Cut Canes, ready for being planted.

Propagation by means of Layers.

The third mode of propagating vines is by *layers* (French, *marcotte;* German, *Senkrebe*). A long cane, still in connection with the vine on which it grew, is partly buried in the earth, and caused to grow roots, after which its connection with the mother vine may be severed.

For this purpose the canes nearest to the soil are most commonly available, but when the old wood has grown very long, it offers no difficulty to the bending down. The interring of wood older than one year has no advantage, as it does not easily grow roots. But when the one-year cane is too short to furnish the layer by itself, a portion of second or third year wood may be interred without disadvantage, but must be cut off when the young vine is severed and transplanted. This method of laying offers an easy way for rejuvenescing old vines grown against the walls of houses. When the young vines produced by laying are cut off, the stumps of old wood may be made useful by grafting, or the grafting may be effected already at the time of the laying. In the first year the layer is allowed but two eyes above ground; of the two shoots the weakest is pinched, but not suppressed. After transplanting the young vine is allowed only two eyes to the strongest shoot; it should not be allowed to bear fruit before the third year.

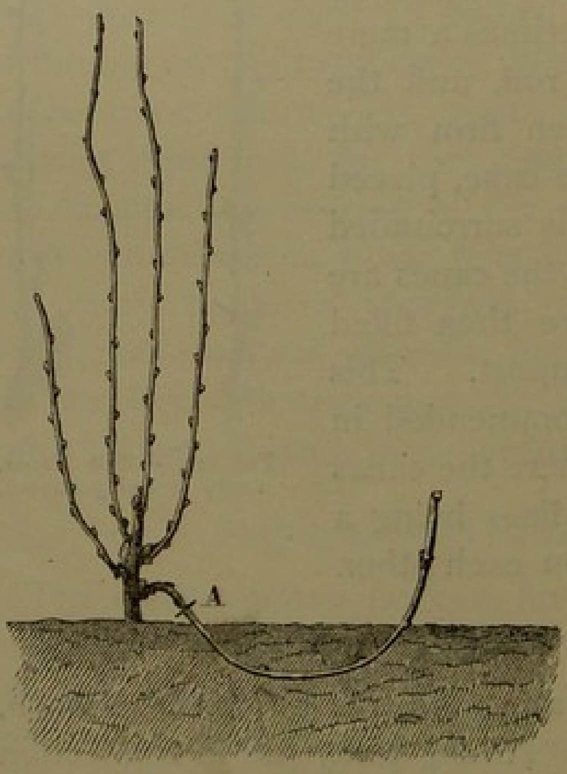


FIG. 13. — Vine, one of the canes of which has been buried to form a *layer*. A signalizes the point at which the cane is separated after the layer has struck root.

Such young vines by layers are prepared for sale by being immersed in a split basket filled with earth and buried in the earth. In the autumn or spring following they can be severed by a cut and removed, basket and all, without disturbing the roots. The entire lump, vine, earth, basket and all, is placed into a strong fresh basket, and sent to its destination. There it may be planted with the old basket, which will not interfere with the development of the vine, but furnish a little manure by slow decay.

This *laying* differs from *provining* by affecting only a part of the vine, one or two of its canes, while its principal stem remains undisturbed and above ground. But in provining the entire vine is put under ground, and nothing but one or two of its canes allowed to appear above ground for the purpose of forming a new vine. This latter method is habitually used in the Champagne.

Multiplication by grafting.

This process implies the existence of a rooted vine of some years of age, which it is desired to change in character either wholly or partly. The processes applicable to effect this object are essentially the same in result, but differ in mode. We distinguish four varieties: (1) Eye-grafting, or inoculating; (2) Simple inarching, or healing together; (3) Compound inarching by means of wedge-like chips; (4) Grafting in grooves.

(1) *Eye-grafting.*—This process is the same as that commonly applied to the multiplication of roses. An eye is cut out of the cane adhering to a thin slice of wood, and immediately fixed in a freshly made aperture in the bark of the old vine so that the wood of the eye-bearing slice closely touches the old wood, and the thin edges of the cut are underneath and covered by the previously peeled off living bark. In the case of the roses the little slice of wood inside the eye is removed, but in the case of vines this wood is left. Care is to be taken to perform this operation with perfectly clean and sharp knives, and to plunge the cut eye immediately into the wound in the bark. Any impurity from the knife and more than a few seconds' contact of the surfaces with the air hazard the success of the operation.

(2) *Simple inarching* is a process similar to the operation known in surgery as the Taliacotian operation for the restoration of a nose out of the skin of the forearm. Two vines previously distinct are to be united, and, when this has been effected, one foot and the other top is to be removed or suppressed. The vines are brought into a convenient position with regard to each other, and then a slice, amounting to nearly

half the thickness, is taken off the side of each with a sharp and clean knife, with the precaution that the wounds have the same length and breadth. The wounds are now brought in close apposition. A tie is then placed above the wounds, and another below them; these ties are to enable the operator to take off the main middle bandages at any time without endangering any soft adhesions which may have been formed. The whole length of the wounds is now bandaged rather firmly with tapes of soft matting. As the vines grow and union takes place these bandages have to be slackened and renewed. The growth of the stock on which the new vine is inarched may be stopped at a few eyes past its point of junction with the new one. The union is generally complete in a month, when the bandage may be taken off, but the tie above and below should be retained for some time afterwards. When the young vine shows by its vigorous growth that it is deriving supplies of sap from its new parent, its connection with its own roots may be half severed, and by the end of the season cut off entirely.

(3) *Compound inarching* by means of wedge-like chips. This method effects a better union than the foregoing, but is more difficult of execution. The vines are put into suitable position, and a wound is made upon each in the place where they are to meet. A wedge-shaped slice is now cut from the wound of one vine from below upwards, having its base or thicker end at the upper end of the wound without being detached from the wood, and without being fractured. From the wound of the other vine an exactly similar slice is now cut, but in the opposite direction, namely from above downwards. The two tongues or wedges of wood are now introduced sideways into the clefts prepared for them; and care being taken that all parts fit easily and closely, and particularly that on one side the lines separating bark from wood are exactly placed upon each other, the wounds are closely united by ties above and below, and by bandages of soft matting. The rest of the treatment is as described for simple inarching.

(4) *Grafting in grooves* is similar to the grafting in split

wood which is usually applied to fruit-trees. It is preferred in the case of the vine to the grafting in splits, because these latter do not heal so well, and the opening of the marrow cavity leads easily to internal decay. The vine or branch to be grafted is cut off transversely at a convenient height above the soil, and by means of a hook-shaped gouging chisel a smooth groove about five inches in length, and intended for the reception of the graft, is cut into the stump or stock. Into this groove is now fitted either a simple piece of cane entirely detached, but long enough to stand in the earth, with three of its lowermost eyes, or the cane of a rooted young plant, which can be planted close to the foot of the stock. The cane or plant is denuded of its bark over the surface where it is to come into contact with the groove in the stock. When everything fits closely the ties and bandages are applied; three eyes are left to the graft above the union.

Fig. 14.—Hook-shaped gouging chisel for producing grooves for grafting.

In all cases it is desirable to cover the entire place of union with some soft wax, or some preparation of mastic, in order to exclude the air, retain sufficient moisture at the place of union, and prevent an excessive flow of sap. This kind of grafting can be executed upon any branch of any vine at any height above the soil. The graft may be detached absolutely, and not dip into any earth or water at all; or it may dip into a lump of moss kept wet, or into a pot of earth; or a young vine in a pot or a layer in a basket as described may be used, and fixed at a convenient height while union is taking place, and subsequently cut off and used elsewhere.

Some viticulturists have stated that grafting could not be successfully practised above ground, but that any vine on being grafted must be provined, *i.e.* buried in the earth entirely, including particularly the joint of grafting. On investigation we find that this experience and prescription refers to the mode of grafting which inserts two wedge-shaped canes into the split stock, and of which we have already stated the disadvantages when it is so practised, that the joint is left above ground. The principal objection to grafting with interring, appears to be that the new vine will have its own permanent roots, will thereby soon dispense with the sap of the stock, and therefore lose the influence and advantages of the latter. But in that case the use of grafting would be limited to giving to the young plant a start by the immediate introduction of made

FIG. 15.—On the left is seen a vine cut off transversely, and provided with the groove for receiving the graft. Close to it is the graft with the bark removed where it is to fit into the groove of the stock. On the right is seen a rooted graft, and close to it its appearance after planting and grafting are completed.

sap. An earlier harvest would then be the only probable advantage of so laborious a proceeding. If, however, the laying of the stock and graft into the ground were intended to last only until a complete union had been effected, and the grafted plant were then raised out of the ground and any roots cut off, the process, though troublesome, would be advantageous in dry situations and seasons, and in unpractised hands.

SUMMARY OF GENERAL PRINCIPLES OF THE CULTIVATION OF THE VINE.

When the soil of a piece of land intended to be formed into a vineyard, or any piece of soil intended to bear a vine, has been prepared in the manner indicated in a former paragraph, the planting of vines may begin. For this purpose mere canes may be employed, as described in the paragraph on multiplication, or rooted vines taken from a nursery may be used. The latter will be more costly than the canes, but have the advantage of bearing a year or two sooner. Rooted plants must be transferred in March, but canes, when preserved under ground in the manner described, may be planted at any time during March, April, May, or June. All vines should be placed in parallel lines, the lines to be distant from each other at least one metre, or a little more than a yard; and the single vines to be removed from each other by the same interval. Plantation of vines in disorder or in quincunx is not so advantageous for cultivation by the plough; but the quincunx may be employed where manual labour is relied upon, and short, small vines are reared. The young vines reared from canes are not cut or interfered with in any way during the first three years. The vines growing from rooted plants are left to themselves for two years; they are allowed to grow into a jungle or thicket, and in any direction they please, but the ground is freed from all weeds. This free growth is necessary to favour the utmost development of the roots. The same principle is adopted by gardeners when first planting vines in vineries. They allow them to grow five or six canes each during the first year, without pinching or shortening, and obtain vigorous wood, capable of bearing much fruit in the next year (the third of the vine). The vine is best pruned for the first time in the fourth year of its growth, this being the third after planting in the case of rooted vines. The pruning must then be mainly directed to the training of the future stock, and the production of a first harvest must be a subordinate consideration. Now is the time when the viticulturist must choose one or other of the many methods of training the vine which we shall describe in the topographical chapters. The particular principles of these methods are generally the same. It is required that every plant should grow every year *at least* two long branches: of these one is to produce fruit in the next year, and no long branches or wood; while the other is to reproduce the two long branches by means of which fruit and wood are to be reproduced in the following year. The branch which has borne fruit is cut off entirely in the spring following the harvest. We now suppose the simplest case, and that the viticulturist has before him the young stock, from which everything has been cut away except the two principal branches or canes. He should select the strongest for fruit, and cut it down to a length not exceeding a yard, and not less than half a yard, in direct proportion to the strength of the vine. This fruit-branch he should now attach horizontally, near to the earth, to a stretched wire, or to a couple of stakes; the other branch he should cut back to a spur of three eyes. When the fruit-branch has formed its shoots and the buds of flowers are seen, all shoots without flower-buds should be broken off absolutely, while all others should be stopped by pinching off their tops above the sixth leaf with the nails of the thumb and index-finger. The shoots of the wood-spur must never be pinched or cut back under any circumstances. They produce but few grapes, and must be kept in vertical position, and tied in a bundle to a stake. This simple vine—consisting, after pruning in spring, of a stem or foot rooted in the ground, a longer cane for fruit-bearing, and a short spur for wood-bearing—may be said to carry one *viticultural element.* In practice, a single foot may be made to carry several such elements. Thus in the Rhenish basket cultivation a foot carries from three to five elements—that is, older branches—on each of which, at the time of cutting, a fruit-spur (three eyes) and a wood-spur (two eyes) are left. The Médoc vines have regularly two elements, but the spreading large vines on walls and in conservatories may have any number of such elements, up to several hundred. It is clear that the greater the number of elements on a single trunk, the greater must be the region for the development of its roots. It is therefore necessary to give to vines which are to grow on the extension system a greater amount of wood under ground at the time of planting, so that they may be able to form many collars of roots. As the extension system involves the gradual rise upwards from the soil of the branches of the vine, it can only be practised in vineries, and against walls and houses, but is not suited for the growth of the vine in open vineyards, where to ripen grapes they have to be kept near to the ground. Every vine, with a proper element or number of elements, and which occupies the required square metre of land, and receives sufficient nourishment, ought to be able, without exhausting itself, and without interfering with the growth of neighbouring vines, to produce sixteen bunches of grapes on the fruit-branch, and four bunches on the wood-branch; altogether twenty bunches, weighing, on an average, fifty grammes per bunch, or one kilo per vine. Three times in every growing season all the branches must be tied up and fixed to the stakes and wires, so that the lines may be maintained. At the same time all unnecessary shoots must be carefully removed; no herbs of any kind, whether useful or weed, must be permitted to grow in the vineyard. The soil must be repeatedly loosened by means of the hoe or plough, but deep cultivation ought to be reserved for spring and autumn. In all vineyards the produce of which can attain a certain minimum value—say of thirty francs per hectolitre—the vines should be protected against early frost, chilling of the blossom, hail, and autumnal rain, by means of straw mats. These mats will also hasten and make more perfect the maturity of the grapes. This precaution will increase the return of any vineyard by one-third on an average of twelve years, although, of course, a part of this advantage will be absorbed in expenses. Every year, during the time from the 15th of April to the 30th of May, twenty kilos of powdered sulphate of iron or green vitriol must be strewn over every hectare of vineyard. In vineyards where the oïdium has appeared, twenty kilos of flowers of sulphur must be dusted over all the vines, either with bellows or fumigating machines. In autumn the manure, compost, mineral nourishment, or other material necessary for the improvement of the soil, must be carried to each vine in proportion to the crop which the viticulturist wishes to obtain; and in an inverse ratio to the natural resources of the soil. In dry situations care should be taken that a supply of water be available for irrigating the vine during the summer's growth. Wet vineyards should be so arranged that the water can be drained away during wet seasons, but retained during droughts. Select varieties of vines should exclusively be cultivated.

CHAPTER III.

SPECIAL ELUCIDATION OF THE PRINCIPLES OF VITICULTURE.

Cultivation of the vine in low lines and on a permanent trunk.—Provining as distinguished from laying and producing a new trunk.—Pruning of the vine.—Time for pruning.—Pinching and cutting the new branches or shoots.—Treatment of the vine during vegetation.—Support and protection of the vine.—Necessity of protecting the vine against early frosts, spring rains, and hail.—Mode in which the vine is touched by early spring frosts.—Varieties of vines to be selected for cultivation.—Selection of the most suitable species for the different parts of France.[1]

CULTIVATION OF THE VINE IN LOW LINES AND ON A PERMANENT TRUNK.

THE cultivation in lines is of all modes the most suitable for the vine, as it permits the application of all the means and instruments which can be moved either by the hand of man or the power of animals. Digging, hoeing weeding by hand, and ploughing by means of oxen as in the Médoc, or by horses or donkeys, are all possible without producing any injury to the root or branches of the vine. And whereas the cultivation of the soil by means of animals can be done much more cheaply and rapidly, and, we believe, much more effectually, all vineyards in situations which admit of the introduction of animals should absolutely be planted in lines. There are of course a great number of steep slopes where men only can perform the work, but even here the advantage of the plantation of vines in low lines will become strikingly apparent, for the linear arrangement admits of a quick inspection of the property, of the condition of its cultivation, and of the work which has to be done to it. By a single glance of the eye along the line of his vines

1 Compare Guyot, Viticulture; R. Charmeux, Culture du Chasselas; Lenoir, Traité de la Culture de la Vigne.

the proprietor ascertains the state of his plantation, and the care or carelessness of his workpeople. The superintendent in the same manner observes the amount of work done and the manner in which it has been performed. A third reason for the arrangement in straight lines is that the means of protection and support are easier, stronger, and cheaper than in the other arrangement. Moreover, the distribution of the manure in equal proportions throughout the vineyard is greatly facilitated. The cut off dry branches, the broken out green branches, and the product of the vintage can be carried easily out of the vineyard. Then the rays of the sun can warm the soil between the lines without striking the vines themselves any the less. The earth on its part gives out the heat again at night which it has received during the day, and thereby beneficially continues the assimilation of the plant. Lastly, the arrangement in these low lines facilitates the circulation of the air throughout the whole vineyard, and thereby confers an advantage upon the vines which they do not enjoy in places where they are irregularly and densely planted. The principle of keeping the bearing part of the vine as close to the soil as possible has been recognized as true everywhere, and it has been acted upon; and we shall show in the topographical part of our treatise many instances in which the neglect of this rule produces bad wines even in countries where excellent wines could be produced. The nearer the grape is to the soil, provided always that it be out of the reach of the splash of dirt caused by rain, the more it will mature and the greater will be its perfection. On the other hand, the higher the grape is from the soil, the more watery, acid, and flavourless will it be. The viticulture of all Italy, and those cultivations elsewhere which we have described as bower cultivation, are striking evidences of this fact. Of course it is a necessary consequence of high cultivation that the rays of the sun are prevented altogether from striking the soil, and there is, in the shade of the vines, a coolness and freshness which may be beneficial for all kinds of vegetables; and therefore it may be useful for any man to cultivate a bower to protect his vegetables, but he is sure to get bad wine. That which the soil does for the vine in low cultivation can be effected with high cultivation if it takes place against a wall. Here the wall, while exposed to the sun, absorbs heat and radiates it back again during the colder part of the twenty-four hours. The airing of the vine is a matter of the greatest importance. Crowding is as injurious to plants as to animals. There are daily currents of air carried into a vineyard containing limited quantities of carbonic acid, which is absorbed by the leaves and goes to augment the body of the plants. How insufficient this air is to feed vines which are very much crowded can easily be seen in the Champagne, where along the open paths the vines bear large grapes in great numbers, while in the interior of the densely planted vineyards, some of which contain as many as 40,000 vines per hectare, the grapes are small and few in number. This shows in a most striking manner the effect of crowding. 40,000 vines upon an hectare of land are more than double what ought to be allowed on it. The low lines have the disadvantage of being more subject to the frosts of spring and winter. They are not perfect unless one adds to this mode of culture the use of straw mats for protection. But even if this protection be omitted, they have still many advantages over a higher cultivation.

PROVINING AS DISTINGUISHED FROM LAYING AND PRODUCING A NEW TRUNK.

To lay means to bury, in a trench made for the purpose, a branch of a vine, which remains fixed to the trunk on which it has grown, and to cover it with earth and manure, in order to entice it to draw roots at all the nodes, and to grow vigorously at the one or two terminal eyes which are allowed to project above the ground. One or more branches of a vine may thus be laid, and after separation from the original plant become independent vines. But provining consists in the sinking beneath the ground, to the depth of six or eight inches, of the entire trunk of a vine, and of leaving only some canes of the last year exposed to the air. In the Champagne, this burying of the vine is effected about every three years, and in the Bourgogne as often as it is required to produce young vines. According to some viticulturists, all kinds of provining are hurtful to the quality of the grape, and in no case is it essential for the production of quantity of wine, if proper modes are adopted to supply its apparent advantages. The practice of elongating the underground part of the vine by successive layings, during the first two years following upon the planting, is justifiable and necessary, where it is intended to produce grapes on a wall, or by other high cultivation; and indeed, for the production of good eating grapes, it is almost indispensable. But in none of the great

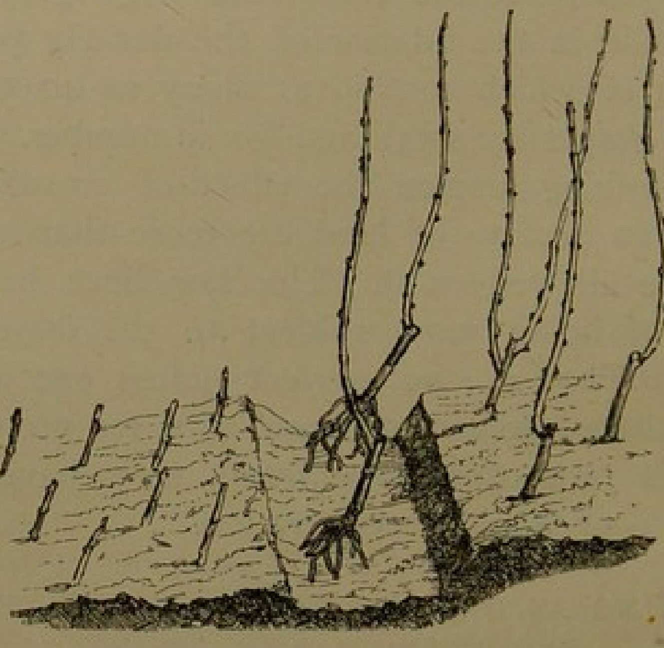


FIG. 16.—Mode of provining in the Champagne. In the trench in the middle are seen vines with partially exposed roots ready for being sunk. On the left vines project from the re-arranged ground.

vineyards of France is provining practised. In vineyards where provining is carried on, such as those of the Champagne, there are frequently found from 20,000 to 40,000 plants per hectare, yet a vineyard with only 10,000 vines per hectare can produce, and actually does produce, more than a vineyard with 40,000 vines. There is a minimum of space without which a vine cannot exist, or at all events cannot develop itself, so as to produce perfect fruit in large quantity. It has been ascertained by observation that a square metre is the smallest space on which a single trunk of vine can be fully developed. Now, wherever vines are crowded on a smaller space, they cease to bear, and the consequence is that the vine-dressers are obliged to make them run through the ground, and seek nutriment in all parts. This is the explanation of the practice of provining. Provining, therefore, is suitable only for very poor soils, and is a mere waste of labour where a good trunk can be developed and maintained. When a trunk is developed on a square yard of soil, the whole territory which it pervades with roots is equal to a cubic yard. Nay, it strikes even deeper than that, and we have seen roots of vines which have penetrated for two or three yards into the

Fig. 17.—Vine trained according to the system of Guyot, as it appears in autumn, after removal of fruit and leaves.

narrow crevices of rock on which the soil was situated. Such a vine is vigorous. The field from which it can extract fertility is many times greater than that which is at the disposal of a vine constantly reduced to surface roots. It is not subject to the influence of drought, and its age, under all circumstances, will be much greater than that of the provined plant. The provining of the Champagne has been tried in the Rhenish districts, and has nowhere yet been found to answer.

PRUNING OF THE VINE.

In almost every manner of vine-pruning the principle has been observed that there should be a long cane for the bearing of fruit, and a short spur for the production of canes for the next year. A trunk which stands in a cubic metre of soil is capable of producing a great many branches, which would cover a much greater surface than a square metre. It is therefore necessary to retrench the growth of this plant by means of the knife, and to direct its activity to the production of perfect fruit. If left to natural growth, without any restraint by the knife, the vine remains very fertile, but the fruit is always small and sour, and ripens very much later than that of the cultivated plant. This is even the case with a vine the cutting of which has been omitted only once. In the second year its fruit is numerous but small, and its canes are thin and unsatisfactory.

Now we will assume a vine trained according to the system particularly advocated by Guyot. It has grown four upright branches, and its horizontal fruit-branch has had five shoots with fifteen grapes. This horizontal branch, shown in the drawing (p. 75), is cut off as near as possible to the trunk of the vine. Of the other four branches of wood, that one is selected which yields with the greatest ease to the horizontal deflection, and fulfils the conditions of a fruit-branch, namely, that of having large nodes and well-developed eyes. It is not necessary that this branch should be the thickest as regards its wood. This branch is now left as long as possible up to a length of one metre, and is tied down in the manner which is illustrated in Fig. 18, next page.

Of the remaining upright branches two are now cut away entirely, and one is cut off above its second eye, counting from the trunk. The trunk now represents the figure shown in the drawing. A vine dressed for the summer growth, therefore, consists of nothing but a trunk, a bearing branch of a metre in length, and a spur for the growth of wood. It sometimes happens—and we have observed such cases in the Graves of the Bordelais—that cultivation according to this system is made impossible for a season by meteoric accidents. Thus, at Carbonnieux, much of the wood which could have yielded bearing-branches had been broken by hail, and on many vines there was no wood at all from which to cut a bearing-branch. In that case the vine-dresser has to cut the vine in such a manner that the greater part of the growth may be upright in order to produce new bearing-branches for the next year. This method, recommended by Guyot, has been practised with an incontestable success by himself as well as by others, and we have seen its effects, particularly at Carbonnieux.

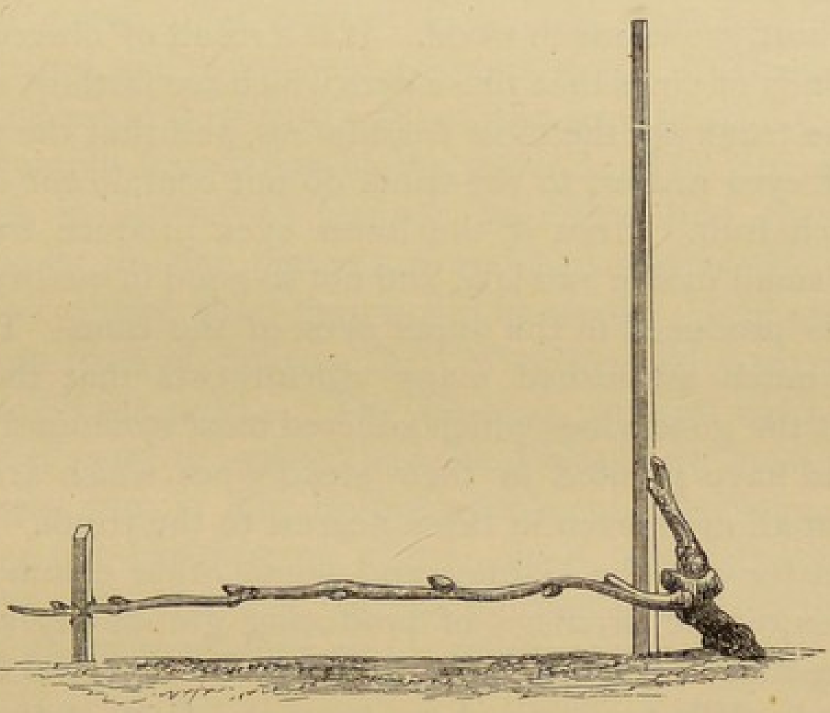


FIG. 18.—Vine trained according to the system of Guyot, as it appears after being pruned.

Even old vineyards which were hitherto cultivated upon the irregular system of the Bourgogne are now being redressed upon this system, and in the notable case of M. de la Loyère, for example, the following result has been attained. The vines cultivated by the ordinary method produced two; the vines cultivated by Guyot's method produced in the first year four, in the second year seven. The dressing of the vine leads to the uniform experience that the shorter it is cut the more wood it will grow, and the longer it is kept the more fruit will it bear. A vine may be so exhausted by long cutting that it produces little or no wood for the next year, and of course the prospect of a second harvest will be very questionable. It is therefore necessary that the vine-dresser should find out for each vine, or species of vine, what is the amount of pruning which it ought to undergo in order that it shall produce each year a proper amount of grapes, and at the same time a proper amount of wood for the next year. In this respect no special rules can be established. The vine-dresser must know his vine, and, if possible, some of its history, and then exercise his judgment for its benefit. If a vine is cut short altogether it grows much wood, just as the one branch on the one trunk, if cut short, grows much wood. It is a result of observation of most kinds of vines that those eyes which are farthest removed from the trunk are the most fructiferous, and that the first two or three eyes nearest to the trunk do not contain the embryos for much fruit. Even if the lower eyes produce fruit, it is mostly small in size and late, and not so good in quality as that which is produced in the upper eyes of the cane. This fact has so much astonished many viticulturists that they have torn out the good vines which adhered most strenuously to this rule, and have planted in their stead vines which are fructiferous in all eyes, even in those nearest to the trunk. Among these latter are the Gamay, and some other common vines which enjoy the privilege of producing grapes in every eye, be it the first or the last, or be it an eye just pushed from the old wood. Whatever may have been the frost of the winter, or whatever may have been the cutting, short or long, the Gamay produces always. Guyot asserts that the finest vines possess as much fruit, and can bring forth as many grapes as the commonest qualities, but they do not bring fruit in the same place, and do not yield it under the same conditions of cutting. They have their finest embryos in the highest parts of the canes, which are far away from the soil. When these canes are lowered in the proper season, in their whole extent they produce an abundant and valuable harvest. If the viticulturist desires to have only four fructiferous eyes upon a cane of one metre in length, he should not cut off the eyes farthest removed from the trunk, but those which are nearest to it, and leave the four eyes farthest off. Among the fine vines the first four eyes are almost always sterile, while the four last are almost always fertile. When a vine-dresser cuts his vine upon spurs of one or two eyes, he cuts off his best harvest. The long branch, or fruit-branch, satisfies the longing of the vine for an expansive and vagabond existence, and maintains its strength, and thereby its fecundity. Near Samur, Guyot observed vines in lines which were trained along little palisades. They ran on the earth to distances of 20 yards, and they ran together, groups of five or six being tied together here and there by means of osiers. Yet each of these long vines had only one terminal cane, and sometimes a second spur. In this manner each vine produced its fruit only at distances of 10, 15, and 20 metres from its foundation in the ground. The vine-dressers explained, in answer to Guyot's inquiries, that they were obliged to let the fine plants run, and particularly the Pineau, for if they cut them short they would be sterile. Here and there upon these rows of Pineaus there were planted Gamays, and they were all cut short. "The Gamays we must cut to make much wine," said the men, "and the Pineaus we must let run to get good wine." The Samur people run the Pineau above ground as the Champagne people run it below ground; but the Samur people were so far the more prudent that they did not allow the vine to draw many collars of new roots.

TIME FOR PRUNING.

The pruning should be effected as late as possible if the cultivator wishes to know what he is about, and wants to produce flower-buds (German, *Schein;* French, *montre*). If he can employ the regular means of protection against the frosts of spring, he should effect his pruning only a few days previous to the filling and opening of the buds; that is, between the 15th of March and the 15th of April, in climates similar to that of Paris. Some viticulturists are afraid of the effect of the bleeding of the vine. We have ourselves always obviated that by rapidly passing a red-hot iron over the cut surface, which produced an instantaneous arrest of the exudation of the sap; but experiments related by Guyot and made by M. Dugué, the chief engineer of the Department of the Marne, show that this is by no means necessary. One hundred and twenty vines of the same age in the same territory were cut, one-half being cut with a long cane and a spur, the other half with three spurs of one and two eyes, before any movement of the sap had taken place. Sixty vines which stood in a line by the side of the former, were cut upon three spurs of one and two eyes in such a manner that they all bled profusely. Sixty vines by the side of these were cut in the same manner, and immediately cauterized with a red-hot iron. Lastly, sixty vines were cut with one spur and one long branch during the rising of the sap. The branches and the fruit of the vines which had been cut in this last manner, when compared with the sixty which had been cut long before the sap had got into motion, were not inferior to the others. On the contrary, those which had been cut short and cauterized evidently yielded branches which were less vigorous than those of the vines cut similarly and not cauterized, and these latter short-cut vines gave hardly any fruit compared with those which had been cut with long wood. It is upon the basis of these and other observations that Guyot states that the bleeding of the vine is not only not hurtful to it, but in most cases beneficial. This being the case, one of the ordinary inducements to cut early in February, March, and so forth, or even in autumn, as is done in the Gironde, entirely disappears. If the viticulturist can cut at the time that the sap rises he is able to do his vines a great benefit, inasmuch as he is able to judge of the condition of the eyes. How often are three or four lower eyes spoiled by the severity of the winter, but the upper eyes are hardly ever spoiled; and as the fact of whether they are spoiled or not can best be ascertained by seeing them swelling in spring, or remaining immovable, the period at which that can be seen should always be awaited. Indeed, there is no disadvantage in late pruning. Pruning may be as well effected in April as at the end of May, when all the eyes have shot forth and exhibit their shows. One can then select all the fruit, leaving no more than is necessary or convenient to the strength of the vine, and remove all that is unnecessary or hurtful. The experiments of Guyot made on nine acres of old vineyard at Argenteuil, in 1845 to 1847, were extremely successful. The sterile branches were all broken off between the 15th of May and the 15th of June. The fruit-branch was then chosen and laid down horizontally, and the other branches were cut off, taking care to leave only two or three wood-growing branches.

PINCHING AND CUTTING THE NEW BRANCHES OR SHOOTS.

The wood-branches are never cut or pinched during their period of growth. They are allowed to attain the full size.

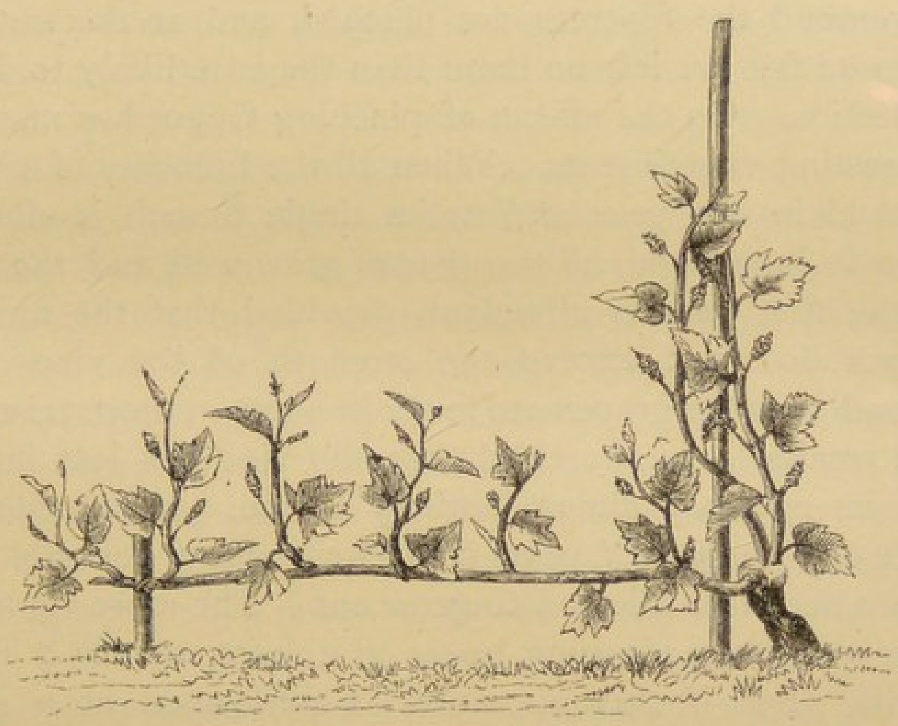


FIG. 19.—Vine trained according to the system of Guyot, as it appears at the period of growth when the flower-buds are developed and pinching may be effected.

All the shoots of the fruit-branch are cut above the sixth leaf. Two methods are in use to effect this purpose. One, called pinching, consists in taking off the point of the shoot at the time it is no bigger than a lentil, with the nails of the thumb and index-finger. The other consists in allowing the branch to attain a greater size and then cutting off every part of the branch above the sixth leaf. The latter operation has been known much longer than the former. Although invented about fifty years ago, the effect of the pinching has not been well studied until the last fifteen years. The application of this method is by no means so general as it ought to be.

The object of the pinching is to prevent the vegetable juices from producing an exuberant branch which is quite useless, and to force all the juice into the fruit on the one side, and into the remaining leaves, eyes, and branches on the other side, thereby to assure the formation, increase the volume, and quicken the evolution, ripening, and perfection of these latter. This method has been employed for a long time, with the greatest success, in the production of melons, peas, tomatoes, and a great many other vegetables. At Argenteuil the fig-trees are pinched, and at the same time no more figs are left on them than they are likely to bring to perfection. On the effects of pinching Guyot has made some interesting experiments. When all the branches of a vine are pinched in one year, and not a single branch is allowed to grow to long wood, all the grapes grow well and the harvest of the first year is abundant, provided that the number of grapes does not exceed the strength of the vine. In the second year the grapes are fewer in number, more transparent, and smaller. In the third year the vine has lost its vigour, and its eyes are almost entirely barren. It remains in this state any number of years if pinched, and it does not become fertile until it is allowed to grow out. The more vigorous the vine was when pinching began, the more rapidly it becomes sterile. But if this operation is performed at a different period, and in a different manner, it has different effects. If all the branches are allowed to grow as far as the first sap will carry them, and are then all broken off, the only effect produced upon the vine is that the second sap goes more into the fruit, and the fertility of the vine remains undamaged. But it is by far the best course to apply both methods to the fruit-branch only. We therefore advise that every vine-grower should allow all the shoots of the fruit-branch to attain the size which the first sap will give them, and should then cut them off two eyes above the last show; that he should entirely break off all barren branches, but that he should not in any way or at any time shorten or interfere with the upright wood-branches. The exact period at which the pinching or cutting off of the fruit-branches should be carried out is subject to variation. It should be borne in mind, however, that it may have a beneficial influence upon the blossom by giving it more juice, and thereby preventing its falling off. Probably, therefore, in most cases the time before the blossoming would be the most suitable for breaking off these surplus branches. It is a singular fact that when an eye grows from old wood, and even becomes a very fine branch, it never bears fruit in the first year. This first branch, when producing secondary branches in the, second year, also leaves them always barren. It is not until the third year and the third wood that such a shoot becomes fertile. It seems that the old wood does not possess (except in Muscatels and Gamays) the elements which are necessary for the production of fruit, and that the second year's wood has almost lost them. It is exclusively the one-year canes, and of these the upper extremities most remote from the trunk, which have fertile dispositions. There is also a kind of luxuriant wood with very distant nodes and wide marrow canals, which resembles the old wood in its want of fertility. Such wood is always cut off by the experienced vine-dresser.

Now whereas good wood is necessary for the production of good grapes, such wood must be produced in the first instance. The production of wood is the dominating antecedent of the production of fruit. If the fruit-branch be not moderated by pinching in the first development, or before blossom time, the development of the branches becomes enormous, and ends in exhausting the vine. Pinching must therefore never be omitted. If the first pinching is preferred, it should be done as soon as the two small leaves above the second shows of grapes are developed; and if there is only one grape, then it must be done above the fifth or sixth leaf of the branch. In general it may be said that the most convenient time for pinching is between the 15th and 30th of May in the North of France, and between the 15th of April and the 1st of May in the South of France. As these branches of the fruit-branch frequently begin to grow again from their new eyes, it is necessary now and then to break off the new shoots or laterals, and never to leave them more than four or five leaves each. The great prescription may be expressed in the following words: the vine-dresser must never leave useless branches in which the sap can be lost. Here an important caution is to be observed. The small corner branches (laterals) which grow from the green wood should never be broken off at the shoulder which the leaf forms with the branch from which they start, but they should only be pinched at their ends, and three or four leaves should be left to them. They serve to attract the sap to the eye which forms at their base for the following year. They moreover protect the eye, and are in no wise hurtful to it if so treated; for experience demonstrates that such eyes contain the greatest possible number of fruit shows.

TREATMENT OF THE VINE DURING VEGETATION.

The general rule for the conduct of the vineyard during this period must be not to suffer any useless vegetation on the soil of the vineyard, and not to allow any excessive growth on the vine itself. The absolute cleanness of the soil from the first period of vegetation to the end of it, as regards either weeds or subsidiary crops, is one of the first conditions of the success of the vine. In this respect, as well as in others, small viticulturists frequently commit the greatest faults. They plant or allow subsidiary growths between the vines, and thereby destroy more of the quality of their wine than they gain by these products. The soil of the vineyard must be weeded by the hand, and for that purpose the weeders should be supplied with a small fork by which they can loosen an inch or two of the soil to extract the roots of the weeds. If there are no weeds, the mere digging up of the land in a superficial manner is sometimes advantageous to admit air and warmth, especially after many rains have rather beaten down the soil. The stirring of the surface must be avoided during the time of drought, as it would then increase the evaporation and possibly injure the vine. In countries, however, with a wet subsoil, the frequent and even deep stirring of the top soil is most beneficial. Thus, in the Palus of the Gironde all the weeding can be done by the plough, while in the upper Douro it has to be cautiously done with the mattock, and at Rüdesheim with the hand and a small fork. In parts where the soil dries out, such as steep slopes, it is, on the contrary, advantageous to maintain the moisture of the soil by compressing it, laying slabs of stone upon it, and keeping all the paths covered by turf. The necessity of removing useless branches from the vine is absolute, inasmuch as their presence prevents the sun from striking the soil and the useful parts of the vine. They keep up a coolness and moisture, and thereby retard the general progress of the plant. How weeds and useless branches may combine to destroy the finest climatic advantages we have fully described in connection with the vineyards of Croatia. The French have plenty of similar vineyards, among them those of the Touraine, where old and venerable vines are covered by a luxuriant growth of branches which fall in heavy bushes to the ground, and where the adhesion of the rods to each other by means of tendrils makes the vineyards impenetrable thickets. The time for all these operations must of course be selected. Weeding ought not to be done when the ground is wet, so as to hang to the instruments and the feet, nor when the soil is too dry, so that the weeds are torn off rather than drawn out together with their roots. After abundant rains the vineyard must always be allowed to dry first before the workmen are re-admitted to it; for when earth adheres to the feet and tools it is thereby made in many cases—particularly in chalky soils—so hard that the after vegetation is impaired. During frost, whether strong or feeble, the vineyard ought not to be dug round, or treated with the mattock, or hoed. In spring, as long as there is hoar frost in the morning, no cultivation of the soil ought to be undertaken even for some hours after the frost has been melted by the sun. If the earth of a vineyard be interfered with at the improper time, so much cold may be admitted into the pores of the earth that the vines may become subject to spring frosts, which would not have happened if they had had their proper protection in the earth. In a similar manner the earth must not be opened while there is snow or hail, or while there are fogs which deposit ice. All these proceedings, if taken at the improper time, would have a lasting injurious action upon the vine. In respect to all the operations performed on the vine in the vineyard the viticulturist must select, as every good gardener must, his proper day and hour. The pinching of fruit-branches and laterals should be done at the time when the sun is not too burning—therefore under a covered sky, and if possible at a time when rain is approaching, so that the sudden deprivation of many leaves may not leave the plant in a somewhat defenceless and sometimes drooping state.

SUPPORT AND PROTECTION OF THE VINE.

The rods of the vine require a support. Without this they would mostly lie on the ground, forming an impenetrable thicket, and their fruit would be contaminated by the mud. Moreover, they would very frequently break-off, and the loss of organs thus engendered would seriously interfere with the progress of the vine. All care ful viticulturists, therefore, fix their vines to stakes, the one-year wood immediately after the cutting, and the fresh growth as soon as it has attained proportions fit for the operation. In most parts of France and Germany each vine is fixed to a single stake. This seems to be the most faulty method of all, for here all the branches at a certain height above the ground are tied together into one thick mass, into which neither air nor light can penetrate, and which is therefore, physiologically speaking, dead. In other parts—for example at Chablis and Würzburg—a single vine is mostly provided with from three to five stakes, to each of which a branch of the vine is tied. We shall relate how at Würzburg the four stakes were at one time standing irregularly, and were afterwards put into line. In Chablis and on the Upper Moselle the line has, however, not yet been established. According to the method proposed by Guyot ten thousand vines are planted on the hectare, and these receive 20,000 stakes. Of these ten thousand are short stakes, of half a metre to $\frac{3}{5}$ths of a metre in length. They are sunk into the earth from 15 to 25 centimetres, in a line with the vines, and at a distance of one metre from each other. This small stake, which is called in the Médoc *carasson*, serves to attach the fruit-branch at a distance of 10 or 12 centi-

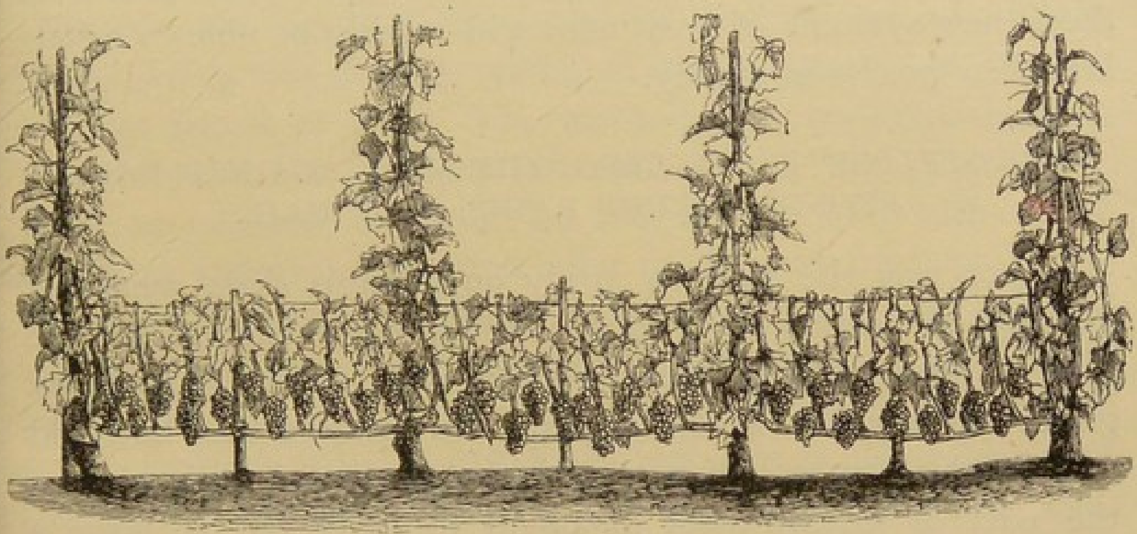


FIG. 20.—Line of Vines trained according to the system of Guyot, with stakes and wires, in full bearing. All shoots of the horizontal fruit-branches are pinched above the wire.

metres from the soil, and to carry somewhat higher than the fruit-branch, at a place which is about 30 or 35 centimetres from the soil, either a lath of wood, or a galvanized iron wire twined round a groove cut in the upper end. This lath, or iron wire, serves for fixing the pinched fruit-branches to it. The 10,000 long stakes are from $1\frac{2}{10}$ths to $1\frac{3}{10}$ths of a metre in length. They are inserted close to the trunk of the vine, in such a manner that the new rods can easily fix themselves to it and rise by it. We represent in Fig. 20 the appearance of vines provided with the stakes and the iron wire.

This mode of applying stakes to vines is much more economical than that which is used in the Bourgogue and the

Champagne. It only requires 300 bottes of stakes for the hectare, while the other methods require 600 bottes; but it also requires 10,500 metres of iron wire, No. 14 gauge. This weighs, with the necessary surplus for attaching in the soil, 600 kilos at 10 centimes a kilo, whereby the expense of stakes and wires comes to 360 francs per hectare. Of course those who practise what is called ordinary cultivation, that is, cultivation such as is usual in their districts without reference to particular theories or scientific principles, will be likely to adhere to old practices; but those who will be capable and willing to comprehend all the advantages connected with these new systems of treatment will readily be able to calculate their profits in money.

NECESSITY OF PROTECTING THE VINE AGAINST EARLY FROSTS, SPRING RAINS, AND HAIL.

Guyot was the first to apply on a large scale measures for the preservation of the vine in open vineyards. He proved incontestably their efficacy, and was rewarded by great success; but he clearly saw and foretold that it would require the utmost courage and the utmost intelligence on the part of viticulturists to assent to carry out so large a proposition. To protect the vines of a single acre of land, it is necessary to spread over them a length of 10 kilometres of straw matting. The mere proposition may appear chimerical to viticulturists; but it has long gone out of the range of propositions, and become a matter of established practice. The worst accidents of the vine in all countries are spring frosts, which destroy the fructiferous shoots; secondly, the persevering and cold rains of June, which prevent the fecundation of the flowers and make the bunches fall off; thirdly, the autumn frosts, which cause the leaves to fall, or to die and get brown, and prevent the ultimate perfection of the grape; and, last, the rains of autumn, which cause the fruit to get rotten. Hail is not so common an accident as those we have above mentioned, and has at least one advantage, namely, that it can be insured against, while no one would think of giving a policy of insurance for any of the other accidents. No expenditure will effect the purpose here indicated which does not rise up to at least 500 francs per hectare, for an insufficient protection which would allow of accident in any one year would not repay the expenses; but if the expenditure here indicated be made, and a vineyard yields on an average 30 hectolitres of wine to the hectare, then the means of protection above indicated will certainly raise the quantity of wine to 60 hectolitres. The effect of the protection is an increase of 30 hectolitres of wine, and it is therefore necessary that these 30 hectolitres shall under all circumstances possess a value of more than 500 francs. However, the application of this method is not advised in places where the average value of the hectolitre of wine is only 30 francs or less. The method also presupposes that the vineyard be planted with fine vines, and that these vines be planted in lines, on low trunks, and with small and large stakes. The protection is afforded by straw mats. These straw mats have a width of 40 centimetres, and are tied by imputrescible twine, or with thin flexible iron wire. They can be rolled like canvas. They are put on on the 1st of April, and not taken away until the 1st of November, or later if the maturity of the grape should not be complete. The vine which has been trained as described above, after the principles enunciated by Guyot, is backed by a small wall of earth thrown up behind it. The long stake is put about 20 centimetres in front of the trunk of the vine, and a third piece of wood is stuck into the little earth-wall and fixed against the main stake so as to rise against it in an angle of from 30° to 40°. This small piece of wood serves as the rafter for carrying the straw mat. As the stakes stand at a distance of one metre, the straw mats are supported at these distances by the wood mentioned; and in order that they shall not be subject to being lifted off by the wind, they are tied at each main stake by means of a little bit of iron wire. It is necessary to expose the vine underneath these straw mats towards the east and south, very little only towards the west, not at all towards the north. The protection towards the north must be absolute,—that against the west nearly absolute ; for it is from these directions that the most dangerous enemies of the vine—the rains and the cold winds—approach. The protection from frost is given by shutting out the sky overhead and preventing radiation towards it. The vine now begins to grow vigorously. In its protected nooks the warmth is caught, and it springs out exuberantly.

Ten men can in one day fix 10,000 metres of straw matting,—that is to say, cover in and protect a hectare. Guyot succeeded in causing ten men to protect 70,000 metres in six days. The straw mats remain in this position to the end of May. From the 30th of May to the 5th or 10th of July they are raised so as to form an angle of 60° with the horizon, being always open towards the east and south, and closed towards the north and west. The rods of the vine grow up along the main stake, and the little earth-wall behind the vine is being diminished by means of the hoe to about one-third of the original height. All the shoots of the fruit-branch are pinched, while the wood-branches of course are not pinched.

During the stage in which the vine has to be protected by straw mats, to save the blossoms from destruction by cold and rain, and during the following or third period—from the 10th of July to the 10th or 30th of September, according to the weather—the mats are fixed perpendicularly to the north and west of the vines. It is estimated by Guyot and Constant Charmeux that this precaution alone will advance the maturity of the vine at least a week. The straw mats now act as little walls, against which the grapes ripen, and if they are blue become dark. Lastly, in the fourth period—the end of the season—in order to protect the leaves from early frosts, and the grapes from rottenness by rain, the straw mat is fixed almost horizontally over the bearing part of the vine, and acts, in fact, as an umbrella against the rain and cold, or intercepts radiation as a screen. These four changes require four operations, which cost 100 francs, including the bringing in and taking away of the straw mats under circumstances in which the wages of a man are two francs for ten hours. Ten men will unroll and fix the straw mats required for an hectare as above stated. The intermediate manœuvres of lifting, changing position, and so forth, require less time than the first operation. On an average, the straw mats last four years. Their price ought not to exceed 15 centimes the running metre. This, therefore, would be 400 francs per hectare per year; at present they cost 20 centimes, which brings the total expense per hectare to 600 francs, which is somewhat too dear. In cases where the vintage is worth 30 francs the hectolitre, and an increase over the ordinary production is attained by the straw mats, an advantage begins to be possible; but where in the fine vineyards the hectolitre is worth 50 or 100 francs, an extra production of thirty hectolitres will of course leave the profits at 900 francs, 1,500 francs, or 3,300 francs per hectare. Guyot protected 62,500 metres of vines by means of straw mats. These occupied five hectares by the side of twenty-nine other hectares, which had been protected against early frosts in spring in various ways; but none was as successful as the protection by straw mats. In 1857 this vineyard in the neighbourhood of Sillery was full of blossoms in all its parts—the twenty-nine hectares not protected by straw mats equally with the other five hectares; but during blossoming time the hectares with the mats did not shed their blossoms, and they produced from thirty to forty pieces—say thirty-five pieces—of two hectolitres each; while the twenty-nine hectares without the straw mats gave from ten to twenty pieces only, or in the main fifteen pieces per hectare. The cold during the blossoming time had therefore caused from fifty to sixty per cent. of the grapes to disappear, although six hectares had been protected by pine branches, six by marsh hay, and by straw hung upon the vines. In the neighbourhood some viticulturists had protected their vines by canvas. This also had afforded no protection, and their vintage did not rise above ten, or twenty, or thirty pieces per hectare.

The matters here stated are by no means mere assertions; but they have been proved by frequent visits of committees appointed by the viticulturists of Rheims and Châlons, and reports of these committees have been published by the engineers Dugué and Baucelin, in the *Cultivateur de la Champagne* for November 1856 and March 1858. Guyot hardly claims any originality in this matter, for he says that he has simply endeavoured to cause viticulture to profit by the experience of the specialists. He says it is only necessary to open the works of Dubreuil, to see the trellises and counter-trellises of Constant Charmeux at Thoméry, and to see the effects of straw mats on the peach cultivation of Montreuil, in order to perceive that he had only profited by their experience and their lessons. In 1858, Charmeux went so far as to cover all his lines of trellis with such straw mats in order to protect them against rain and cold. We can conceive that a process may be economical which protects the fruit of a season, in the neighbourhood of great towns which afford an immediate and unfailing market, and yet not be economical for grosser cultivation ; yet we have no doubt that if this mode of cultivation were undertaken with all the precautions we have indicated, it would everywhere effect a great improvement in the product, a great saving of labour, and a great increase in the harvest.

MODE IN WHICH THE VINE IS TOUCHED BY EARLY SPRING FROSTS.

Many are the surmises which ignorant persons have formed on this subject, and as the evidence of frost upon the young shoots begins first to show itself when the sun rises, the idea has been most common among them that it was the rising sun which killed the shoots. Of course the sun has nothing to do with it. This any person conversant with physics could demonstrate *à priori ;* but it is well that in matters of this importance there should be distinct experiments to appeal to as evidence. All the lines of the vineyard of thirty-four hectares which Guyot planted at Sillery in 1850 ran from north to south. In consequence the greater part of his straw mats, which were then 59,000 metres, opened towards the east, and received the first action of the rising sun. In the night from the 4th to the 5th of May, 1856, and in that from the 6th to the 7th, a frost of three and four degrees struck all the vineyards of the Champagne, and particularly those of Sillery. On the evening of the 4th Guyot, alarmed at the cold, clear aspect of the sky, had caused 300 metres of straw mats to be got ready, and had given orders that if there should be frost in the night those three hundred metres of mats should, before daybreak, be put to the east of vines not otherwise protected. These vines were therefore destined to share all the intemperateness of the night, but not to be struck by the early sun. The instructions were obeyed; the sun rose splendidly, and at ten o'clock in the morning the disaster was evident to all eyes. All the shoots protected by the straw mats against the rising sun had perished, just as well as those which had not been protected at all; and it had been demonstrated that the rising sun had nothing to do with the shrivelling, dying, and browning off of frosted vine shoots. In the night between the 6th and the 7th the same experience was repeated in other parts of the vineyard, where a number of rows had escaped the first night unhurt. The sun-shades did not save a single shoot. But, say others, "It is the cold wind that kills the shoots." On the contrary, say we, the cold winds such as blow about this time will never affect the young shoots, unless there be previously deposited moisture on the shoot sufficient to make it defenceless. Now, what causes this deposition of moisture? The radiation of its warmth towards the sky so reduces its temperature that the moisture which rises from the ground is deposited upon it, and then the wind comes and the shoot, which is defenceless against the effects of evaporation, perishes. It is therefore clear that the cold wind alone has no effect upon the shoot, except in the case when the shoot has previously lost heat by radiation, and had moisture deposited upon it. The dry shoot is protected against wind by the fine fur which covers it on all sides, and which to a teleologist might appear to be expressly made for protecting it against frost. Well, then, prevent the radiation from the vine towards the clear sky by means of straw mats; you thereby prevent your vine from getting so cold that it will deposit moisture, and the wind will then only contribute to keep it all the drier, and insure its preservation rather than its destruction. The vine in clear spring nights dies from radiation, as all the camels died in Bruce's caravan, in the midst of Sahara, under the clearest sky that he ever beheld on his journeys—from radiation of heat into space.

VARIETIES OF VINES TO BE SELECTED FOR CULTIVATION.

Each variety of vine generally preserves its main characters wherever it can be planted so as to produce fruit. Its principal characters appear also in the wine made from that fruit. Exposure, territory, and climate may make a vine poor or rich, but it will never transform it into anything else: the Muscat will not become Carbenet, the Pineau will never become Gamay, the Riessling will never become Chardenay or Tokay. Notwithstanding this remarkable and unquestionable fact, the idea that the variety of the plant governs the product has always been applied only to the so-called great growths. As Guyot expresses it, the idea of the growth has absorbed the idea of the vine, while in reality the vine determines the growth. Plant Château Lafite with Gamay or Gouais, and you will have a detestable wine. Substitute the Gamay for the old vines of the Clos Vougeot, and you will have wine at 60 francs the piece. Take the Carbenet Sauvignon from the Haut Médoc, or the Franc Pineau from the Bourgogne, and plant it at Madeira, at the Cape, in Spain, in Algeria, or at Auxerre, and everywhere you will obtain excellent wines, which will recall the wines of those countries from which you have taken the plants. The exposure, the climate, the higher cultivation, and the mode of making the wine will of course influence their lightness, their richness, their taste, and their bouquet; but the Pineau, wherever grown, will reproduce the qualities of the Burgundy wine, and the Carbenet, wherever grown, will recall those of the Médoc. The Riessling, whether grown on the Rhine, in the Tyrol, in Croatia, or at the

Cape, will always recall the qualities of the wine of the Rhine.[1] The Duc de la Vittoria, Espartero, caused Bordeaux grapes to be planted in his vineyards in Navarre. The wine there produced is true wine of Bordeaux as to taste and richness, but it has an after taste which is sour and bad, and which is found in most Spanish wines. This taste is produced by the methods of preparation and keeping adopted throughout Spain. In the Auxerrois there was a remarkable observation made in the year 1858. The wine made from Gamay was sold at 50 to 60 francs the piece of 250 litres, while the piece of wine made from Pineau was sold at from 300 to 400 francs. It has been alleged against this experience that the Pineaus were grown in favoured slopes, but that is really a groundless objection. The same slopes, if planted with Gamay, would soon lose their reputation, and their wine would sell at perhaps 15 francs higher than the Gamay wine of the common vineyard. It is therefore quite properly that Guyot insists, and we insist with him, that each wine, no matter from what country it comes, should carry with it the name or names of the grapes from which it is made. Thus one should never say "wine of Burgundy," but "wine of Pineau from Burgundy." One should not speak of "Bordeaux wine," but of "wine of Carbenet from Bordeaux," or "wine of Verdot." One should speak of "wine of Fins Plants of Champagne," and not of "Champagne wine." In the Bourgogne there are produced, side by side on one and the same slope, excellent wines from good varieties of grapes and very bad wines from bad varieties of grapes. These varieties are frequently mixed in the vineyard for purposes which may be very justifiable in the eyes of the producer, but which have no bearing whatever on the ultimate product as regards the consumer. The Germans have practically recognized this long since. They call their Riessling wine "Riessling," in order to make fully sure that it is to be understood that this wine comes from Riessling only. The Germans also speak of "Tramine,"

[1] This makes the report concerning Bucellas wine being made from the "Hock grape" rather doubtful.

and we may rely upon it that these are pure wines, because their characters are so striking, and an admixture of other grapes would produce so infallible a deterioration in the quality that only folly could think of effecting such a mixture. If we consider the great growths and the history of their establishment, we shall always find that they were originally produced by intelligent persons who planted favourably situated vineyards with excellent vines. The excellence of the produce was gradually ascribed to the situation only, and the effect of the particular cultivation of the species of vine grown was forgotten. We have now to do the reverse. We have to wake up producers, wine merchants, and consumers to this great law, that the variety of the vine determines the quality of the wine, and that no man ought to be satisfied with a name for a quality of wine, unless he has, at the same time, a guaranteed statement of the variety of vine from which this particular wine has been made. We therefore advise that the finest variety of vines should be planted in all places where it is intended to establish new vineyards. No producer needs to fear that the finest varieties will give him less produce than the coarsest, if he will carefully adopt the method of training most adapted to each. During this century many attempts have been made to determine the relative value of the fine varieties of vines. In the year 1819 the Duc de Decaze founded the Ampelographic School of the Luxembourg under the direction of M. Hardy. Here there were brought together varieties of vines from all parts of the world, but it was found quite impossible to make any use of them. How is wine to be made from two plants? and how can the value of a plant be determined except by its produce, well treated and well matured? The collection was a very useful botanical one, but its viticultural value was *nil*. We have ourselves carefully examined the whole of the vines in that collection for botanical and special chemical purposes; but we are nevertheless obliged to say that it has never fulfilled any of the intentions which were connected with its establishment. Viticulture remained the same throughout France, and even the propagation of good or bad vines was left uninfluenced by this great effort of Decaze. This collection of vines was imitated in various parts of the world. There was one made at Baden, and another at Heidelberg, in which Metzger the botanist took so distinguished a part, and which has served as the basis for the monograph on vines by Von Babo. There is a collection at Gratz, which was made under the auspices of the late Archduke John; and another at the Closter Neuburg, which serves as the botanical school of the Agricultural Institute of that convent. All these have undoubtedly augmented the knowledge of vines in general, and many intelligent persons have thence drawn stock which they have multiplied to advantage; but, on the whole, vinification has not been thereby improved to the desired extent.

Guyot says to viticulturists: "Plant your new vineyards with the finest vines that you can get in your neighbourhood. Each of you can distinguish them perfectly well in your locality. You know their qualities and faults better than the proprietors or men of science. Take the best plants, cultivate them carefully, adopt the mode of cutting which makes them fertile, give them the manure which is necessary, and you will find that the revenues of your vineyard double: you will find that while before your vineyard nourished only one family, it will now feed two. The salaries will augment, the land will get richer, and you will contribute to increase the wealth of France."

To the proprietors he says: "Buy the canes of the reputed vineyards of your neighbourhood; collect the canes of the fine varieties of vines in your own vineyards, plant them in nurseries, and train up new plants which will enable you to replace vines which have died in your established vineyards or to plant new vineyards altogether. Do not provine, but fill up all places which have become vacant by two-year plants from the nursery. Carry earth and manure to the extent to which the vineyard requires it. Maintain your vines with trunks, and cut them upon a fruit-branch and a wood-branch. Do not spare hand labour, and you will find that your wines will be double in value, and that their quantity will be as great as that produced by the coarsest vines."

To the Government M. Guyot says: "Make yourself the instrument of collecting all the canes of the best growths of France immediately after the cutting; plant them in nurseries, and you will have in two years, at a very small expense, millions of vines. If each thousand of these vines be sold at five francs, the revenue will amply cover your expenses. Create in Algeria, in the Landes, in Sologne, in the Champagne, model vineyards and nurseries, from which the deserts which are so close to all these places could be populated; and after ten years the capital employed will return you 10 per cent.; the colonies will be fixed, and the wines of France will be bought by all the world. If to these immediate means you superadd the importation and study of foreign vines, and carry on their treatment to the completion of the process of vinification, you will establish the science of viticulture and œnology on a definite and solid basis."

SELECTION OF THE MOST SUITABLE SPECIES FOR THE DIFFERENT PARTS OF FRANCE.

In the South and South-East Districts of France.

FOR BOX RAISINS.

Mayorquin, ou Bourmen. Panses.

FOR LIQUEUR WINES.

Furmint.
Grenache.
Maccabeo.
Malvoisie.
Muscat blanc.
Muscat noir.

FOR GOOD WINES.

Carignane.
Clarette.
Marsanne.
Petite-chiraz.
Picpoule.
Roussane.
Rousselet.
Rousette.
Ugni.
Vionnier.

In the South-West Districts.

FOR THE BEST WINES.

Carbenet.
Carbenet gris.
Carmenère.
Cruchinet.
Muscadelle.
Sauvignon.
Semillon.
Verdot.

FOR THE BEST BRANDIES.

Folle-blanche.

In the East, the Central, and the Western Districts.

FOR GOOD WINES.

Epinette et blancs-fumés.
Fromentés roses, blanc et gris.
Gentils roses, blanc et gris.
Mesliers.
Pineaux blancs, ou Chardenays.
Pineaux gris ou beurots.
Pineaux de la Loire, ou de Vouvray
Pineaux noir, ou noiriens.
Plants dorés, verts ou gris.
Riesslings.
Savagners.

We now refer the reader to the description of the varieties of vines which we have given in the topographical part under each particular district of cultivation. It would be unnecessary for us here to repeat all the details given in those places, inasmuch as they have reference particularly to those localities. However, as it is our intention to make this work as cosmopolitan as possible, we recommend all enterprising persons to study carefully all the varieties of vines in the parts in which they want to plant them—varieties, of course, which have been selected in the first instance on the basis of the general probability of their success. Nobody can doubt that hitherto European vines have failed in America. The vine of Cyprus taken from Madeira has, however, succeeded well in South America. Those who make plantations in foreign parts should therefore, above all things, consider local experience, and make experiments on a large scale only if they are in possession of all the knowledge contained in this treatise, and can wield it with freedom.

CHAPTER IV.

VINTAGE AND VINIFICATION.

Time of vintage. — Modes of vintage. — Separation of stalks. — Mashing and crushing.—Wine-presses and pressing.—Fermentation.—Production of wine by the process of Petiot.—Special apparatus required and rules for the production of wines by the process of Petiot.—Adjustment of acidity and sugar which ought to be made in must before it is allowed to ferment.—Description of the proceedings for making fruit or grape-wines according to the method of Gall.—Plastering of wine and must.

TIME OF VINTAGE.

WHEN the grapes are ripe they have to be collected in a clean and judicious manner, and to be transformed into wine without any unnecessary delay. White grapes are crushed and pressed; the juice, freed from stalks and husks, is put into clean barrels, and allowed to ferment in a cellar or other temperate place. Black grapes which are to yield red wine are crushed, put into vats, juice, husks and all, and allowed to ferment until the wine is completed, and has extracted the colouring matter. The wine is then drawn off, the murk pressed, and the united products put into barrels. While the principles of the most common methods of vinification are thus easily stated, the details to be noted are so numerous, owing to the variations determined by different vines, customs, and countries, that we must state them in the chapters treating of the viticulture of each œnopoetic district.

The first condition of the vintage is, that the grapes should be ripe. In many parts of the south of Europe it is considered that the grapes are ripe when they have attained their greatest volume. They are then vintaged; but their must being quite unfit for the production of natural wine, has to be plastered, and, after partial fermentation, to be mixed with spirit. It is thus clear that the time of the greatest volume of the grapes is not the one most suitable for the vintage, if the object of the viticulturist be to produce natural wines. In the most celebrated vineyards for the production of white wine, the grapes are allowed to hang until they attain the maximum of sweetness and maturity, and are commencing to decay or to pass into the state of sweet-rot. Thus in the Sauterne district, the best berries of every bunch are cut out at intervals and carried to the press; and an entire harvest of a vineyard consists of several up to eleven separate gatherings of all that has attained the highest state of ripeness. In the finest situations of the Rhinegau, the grapes are not collected until the rains or frosts of the latest autumn necessitate the vintage. At Vouvray as at Tokay, the best wines are made from the grapes which have been longest on the vine, and collected the greatest amount of sugar. But the experience gained in the production of white wines is rarely applied to the red ones; for with them the production of a certain colour is a dominant condition. The colour required by the trade can only be obtained from grapes at a certain stage of maturity, and that stage does not coincide with the maximum maturity which the grapes can attain on the vine. Consequently, the highest quality of the wine is abandoned in favour of a conventional dye; and the unripe wine has to remain years in barrels and bottles before it acquires the qualities which fit it for use. The Champagne grapes, on the other hand, are not permitted to attain the stage of highest maturity, because it is conventional that the effervescent wines of that country shall be as pale as possible, and not have the slightest tint of redness. But whereas fully ripe Pineau always yields a slightly reddish, rosy, or partridge-eye coloured juice, however carefully and quickly it may be pressed, this stage of fullest ripeness is not awaited in the Champagne, and the grapes are gathered at the time of their greatest volume: and whereas fully ripe Pineau, when fermented with the husks, yields wine which has a somewhat tawny red colour, and not the lively dark red of elderberry juice, the wines of Burgundy are, with few exceptions, vintaged at the time when the grapes produce the deepest colour.

Those therefore who would produce good wine should allow their grapes to hang on the vine as long as is compatible with the safety of the harvest. From time to time samples of grapes should be collected from the vineyard, the berries should be mashed, pressed in a little hand-press, and the juice obtained subjected to examination, particularly as regards the amount of sugar and acid present in it. The sugar can be easily ascertained by the use of a so-called *glucometer*, or spindle of glass, such as is used for ascertaining specific gravities in general. The scale of the glucometer should be so divided as to indicate per cents. of fruit-sugar directly, and not imaginary degrees arbitrarily fixed by inventors. But any *gravimeter* indicating specific gravities can be used to ascertain the density of a must, and from that the amount of fruit-sugar contained in it can easily be calculated. Some convenient French glucometers are so arranged as to indicate by one degree of their scale a quantity of fruit-sugar which after fermentation would yield a volume per cent. of the must of absolute alcohol, that is, about 1500 grms. of sugar per hectolitre of must. When the sugar is calculated from the specific gravity found absolutely, the total solids found must not be taken for sugar only, but from one-tenth to one-fifteenth has to be deducted as being other matters than sugar. The sugar can be determined absolutely by the chemical and optical methods of saccharometry described in a subsequent chapter. Must which would yield from 6 to 8 per cent. of alcohol will give only "small wine," and grapes showing this quality of must should not be harvested. When the samples of must produced show above 8 per cent. of future alcohol, the vintage may be contemplated. But it should never be actually undertaken as long as by repeated trials any increase in the quantity of sugar in the grapes is observable. Even when the sugar has attained its maximum, and remains stationary, it is not on that account necessary to proceed to gather the grapes, as, if the season be favourable, they will still undergo beneficial changes by hanging upon the vine. In the north and centre of France must will seldom show more than 15°, but in the hottest regions of the south, in parts of Spain, Italy, Cyprus, Madeira, must is produced which shows up to 24°, *i.e.* degrees of the French glucometer. Of course this sugar can never be entirely transformed into alcohol, as the action of fermentation ceases in any fluid containing above 16 per cent. of alcohol. The excess therefore remains as sugar, as in the liquorous wines of Lunel, and the sweet Sauternes, which are now taking the place of Lunel. If it is not intended to produce such syrupy wines, the must produced can be reduced by the addition of water to 15° or even 12°, and will then ferment completely and produce dry wines of the best character. This dilution of a heavy must is preferable to the harvesting at the time when the trial juice shows from 12° to 15°. If, on the other hand, a must coming from good vines in an unfavourable year shows but 8° of future alcohol, it may advantageously receive an addition of pure cane-sugar up to 12°, every degree requiring an addition of 1500 grammes of cane-sugar to each hectolitre of must. In no case should artificial grape-sugar, or starch-sugar, or glucose be used. We have tried a variety of the best and whitest samples which can be procured, and find that they all impart a nasty taste to the fermented product. When the viticulturist has decided all the questions raised by these considerations, and made his preparations accordingly, he should proceed to the actual vintage.

MODES OF VINTAGE.

The most common mode of vintaging consists in cutting off all grapes and carrying them to the press. For this mechanical operation no particular intelligence on the part of the labourers, and no instructions on the part of the viticulturist, are required. Men, young and old, women, and children, may be employed. Each labourer is put to a separate row of vines, and told to progress to the end of the row. All labourers are required to remain in line, so that the work is equally distributed. They cut the bunches off the vines with scissors or knives, and place them in little baskets. Every full basket is replaced by an empty one, and emptied immediately by the collector, who thus attends to the wants of from four to six labourers. The grapes are best placed into suitable vessels of the capacity of an hectolitre, so that the vintage is immediately measured, and the amount of work done ascertained. A butt of the capacity of an hectolitre will hold 50 kilos of grapes, and with its own weight of 10 to 15 kilos can be lifted and carried by a single man.

The master vintner superintends the entire process. If there is a sufficient number of hectolitre vessels, they are placed side by side on the waggon and carted to the press. If this is not the case, the hectolitres being counted and noted down, the contents are poured into a large vat, which is in attendance on a waggon on the carriage-road of the vineyard. The vintagers may be taught to cut out of every bunch all unripe, corroded, or spoiled berries, and put them into a separate little basket. But it is preferable to entrust this work of clearing the bunches to particularly instructed labourers located at the place of collection of the hectolitre recipients. They should have a table, each sufficient to take the contents of a receiver, and with a pair of scissors should remove all bad parts, and all long stalks and tendrils. They should then separate the good from the bad, and allow the former only to go to the main vat on the waggon. The berries which have been ranged out may, after separation from the worst ingredients, be used for the production of a cheap common beverage. A careful vintage labourer can harvest 125 kilos of grapes per day, which will measure 2½ hectolitres, and produce nearly 1 hectolitre of wine. Five vintagers require one porter, and four such gangs require a superintendent. Such a staff of twenty-five vintagers will clear half a hectare of vineyard per day, and thus collect 50 hectolitres, or 2,500 kilos of grapes, producing 20 hectolitres of wine. The waggon carrying the harvest is best drawn by a horse, and attended by a waggoner and an assistant. Wherever the quantity of grapes is smaller, or the roads are not accessible to a drawn waggon, the harvest has to be carried on the backs of men or animals. But this mode of transport is also elected in places where it is intended to bring the grapes as perfect and uninjured as possible into the press-house, as in the Champagne. Indeed, we believe that in that district the harvests, even of the largest properties, are all carried in panniers on the backs of mules and donkeys.

SEPARATION OF STALKS.

When a load of grapes arrives at the press-house, the question has to be decided whether or not the stalks are to be removed from the grapes previous to mashing. When the grapes are very ripe the stalks are woody, and do not easily yield juice to any pressure, however strong. But when the grapes are less ripe, the stalks are green and succulent,

FIG. 21.—Mode of separating stalks from grapes by stirring with a trident.

and yield much harsh astringent juice on pressure. Practically, in the case of white wines, the stalks are never separated from the grapes; in some cases of light wines, which incline to be viscous, it is even advantageous to leave the stalks in prolonged contact with the must. But this is exceptional, inasmuch as must of white grapes is, as a rule, pressed immediately, and not left in contact with the murk for any length of time. The Champagne grapes are also pressed with the stalks, and the juice of the latter causes the last third of the must which flows from the press to be harsh and of less value than the first parts. With most other black grapes the case is different, because they have to remain in contact with the juice for a length of time during fermentation. If, then, the murk is very astringent, and the stalks are left in the fluid, a harsh wine is produced, which requires years to become drinkable. But the same grapes, fermented without the stalks, yield a milder, better maturing wine. They are therefore separated before the grapes are mashed. This separation of the stalks (French, *égrappage;* German, *Abrappen*) can be effected by various means. A simple method consists in the stirring of the bunches in a tub

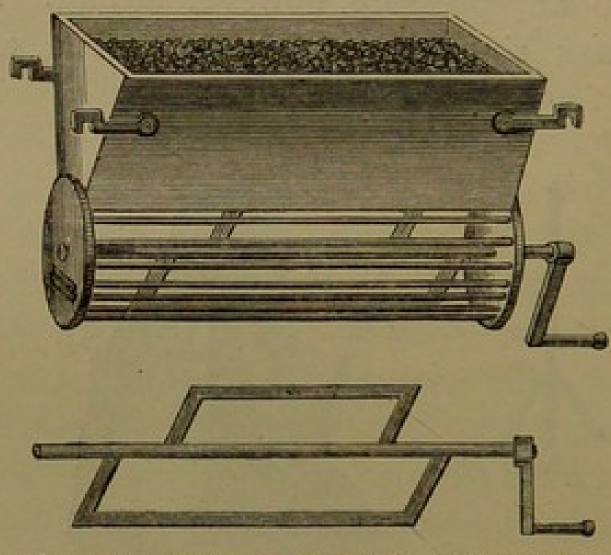


FIG. 22.—Machine for separating grapes rom stalks. The funnel-shaped top is taken from the stand, to show the cylindrical box of parallel wires and stirrers within. The stirrer is again figured separately below. (Reduced to about one-thirtieth of actual size.)

with a trident of wood (Fig. 21): by the rotary action of this instrument the berries are detached and the stalks rise to the surface and are taken off. Another machine consists of a cage of parallel wires, in which a stirrer is revolved by a handle turned outside (Fig. 22). The bunches enter above by a funnel, the berries drop through the interstices of the wires of the cage, which at last contains only stalks to be removed by the hand through a side door. There are also in use various net-shaped trays, on which the bunches are manipulated until the berries have fallen through. This work is not easy upon all varieties of grapes ; ripe Verdot of the palus of the Gironde will drop its grapes like hail when it is merely shaken, while ripe Pineau is not so easily separated. The operation is the more difficult the less ripe the grapes are.

MASHING AND CRUSHING.

The berries, whether separated or not, have now to be mashed or crushed. This must be done with the precaution not to crush the pips or stones, and the stalks if they remain. It has therefore always been a favourite mode of comminution to let the grapes be trodden by men. We believe that this is a very excellent method if cleanly and properly performed. It is done on a wide wooden platform, or in a large tub, and the juice which is pressed out is

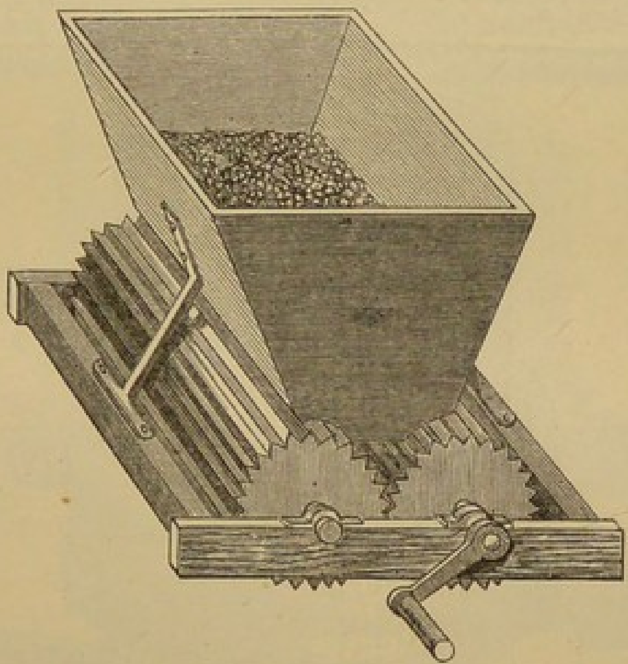


FIG. 23.—Grape mill for crushing grapes, with grooved rollers. (Reduced to about one-thirtieth of actual size.)

allowed to flow off into separate receptacles. In some parts the treading of the grapes is done by men wearing heavy boots. In this case the pips and stalks are easily injured and crushed, and communicate unpleasant qualities to the wine. The same is the case with the ordinary crushing machines or grape mills, which consist of grooved wooden rollers working against each other (Fig. 23). Such machines would be less objectionable, and perhaps be preferable to the feet of men because working quicker, if the rollers were made of vulcanized caoutchouc.

WINE-PRESSES AND PRESSING.

In the preparation of white wine the must is separated as much as possible from the murk before the latter is pressed, so that the volume of the matter to be pressed is as small as possible. In the preparation of Champagne wine the grapes are, however, not crushed at all in detail previously to their being put into the press, and the only crushing which they receive is by the press itself. It is for this reason that the presses in the Champagne are the most powerful of any known. In the preparation of red wines the juice which flows

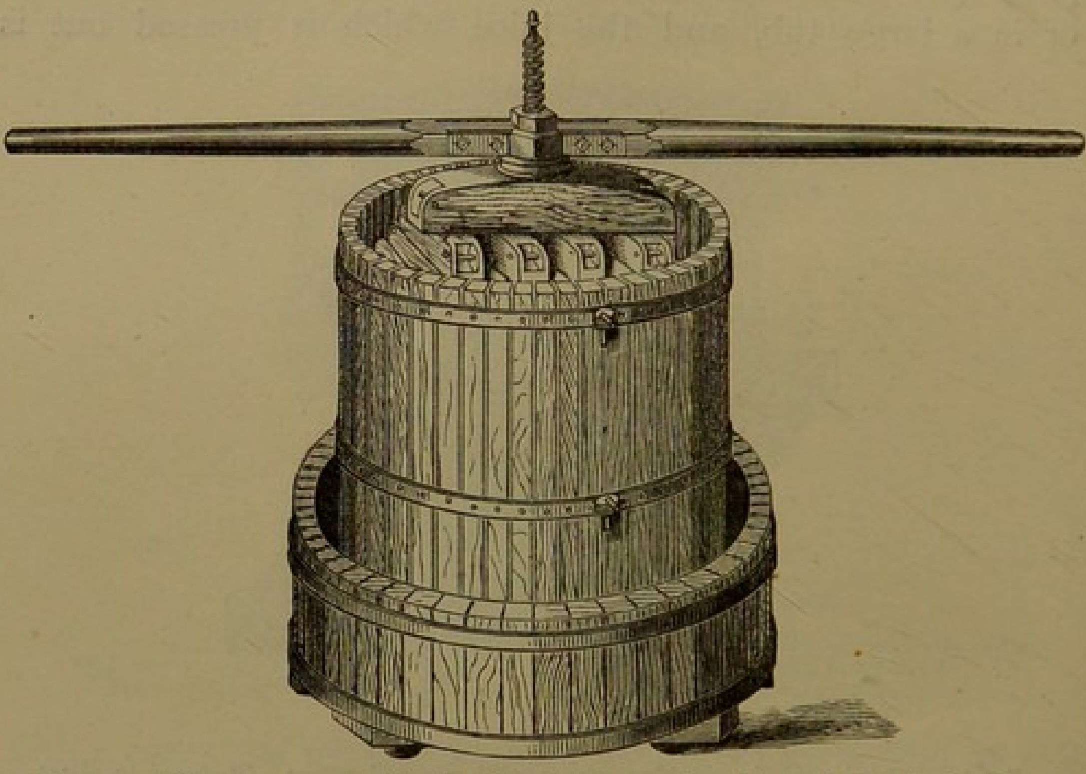


FIG. 24.—Wine-press as used in the Gironde for pressing the murk of red wine after fermentation. (Reduced size about one-fortieth of reality.)

off the platform or press, together with all the husks on the press, and the stalks, if they have not been removed, are put into the fermentation vat. Fermentation is allowed to complete itself, the wine is then stirred energetically with the husks, so as to extract the utmost amount of colouring matter; all the wine which will run off by itself is drawn from the taps, and the murk is put into the press, and the wine flowing from it added to the other. Wherever red wine is made, the platform on which the grapes are trodden serves also as press, an iron screw being fixed in the middle, surrounded by a basket in which the murk is placed. The science of the wine-presses would admit of the composition of a separate treatise. Most of these machines reflect the greed rather than the wise ingenuity of their constructors. No doubt a wine-press should have certain power, sufficient in all cases to effect the object in view, namely, the expulsion of all the juice from the murk. But presses which force the juice out of the stalks and the oil out of the pips are injurious to the wine, and should be

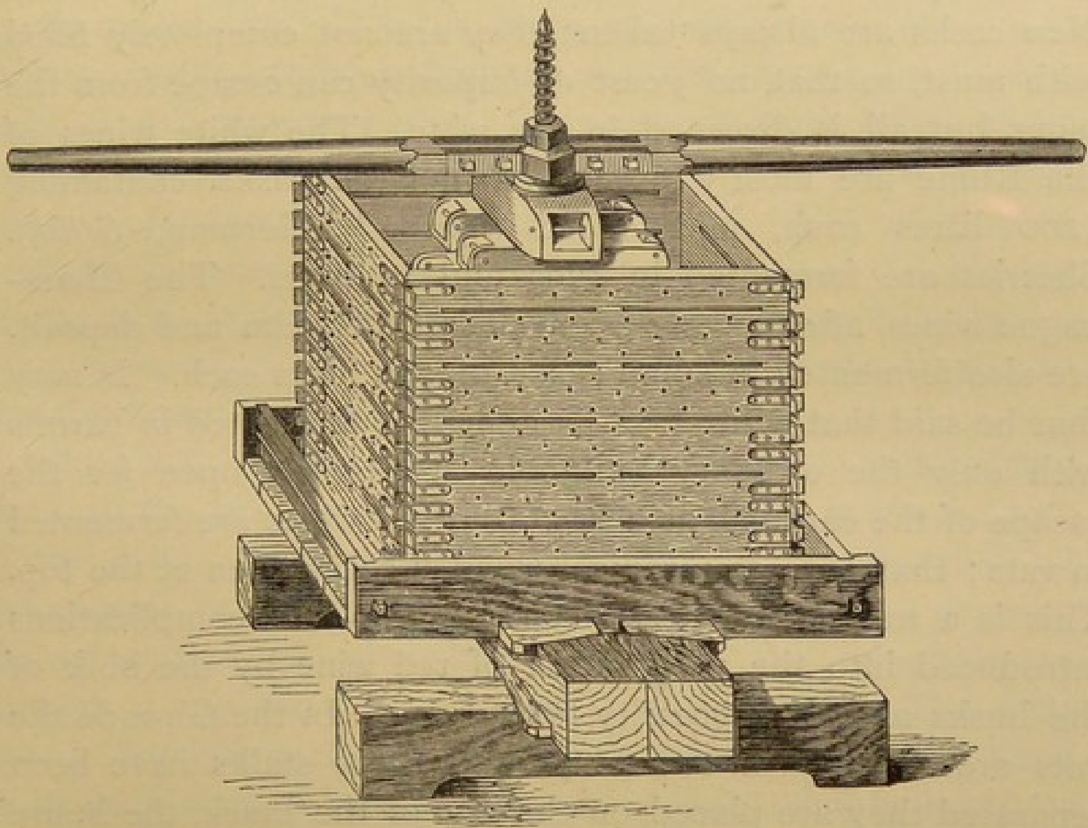


FIG. 25—Wine-press as used in the Gironde for pressing white grapes before fermentation. The box consists of six horizontal sections, which can be put on upwards as the murk accumulates, or removed from above downwards as the compression of the murk proceeds. (Reduced size about one-fortieth of reality.)

avoided, or the juice so expressed at the end of an operation should be put aside and not mixed with the must. The most suitable presses appear to be those common in the Gironde, which have an iron screw in the middle, of a high round basket made of perpendicular laths, destined to receive the murk, and a nut, which is turned upon this screw from above downwards by means of levers, presses the wooden blocks upon the murk, which thereupon oozes its liquid through the basket by which it is surrounded (Fig. 24). It is probable that in large establishments presses will soon have to compete with centrifugal machines, which perform in two hours, with the aid of three men, what presses working upon the same amount of material can only perform in seventeen hours, with the aid of seven men.

FERMENTATION.

The fine white wines of the Gironde are all fermented in barriques, which in this country are called hogsheads. New casks are always taken; they are not completely filled with must, so that no yeast or impurity can escape from the bung, but all is drowned in the wine. The white wines of the Rhine are mostly fermented in large casks, containing 1200 litres each, and called "piece" (German, *Stück*). Sherries are fermented in tuns and in butts. The Champagne wines, after having been cleared of scum and deposit, are also fermented in small casks, of 220 litres each. It may thus be said that white wine is generally fermented in barrels with only the ordinary bunghole at the top open for the escape of the carbonic acid gas. But red wines are fermented in vats; that is to say, conical wooden casks open at the top. This is a mechanical necessity, owing to the complications introduced into the preparation of red wine by the bulk of the husks and the necessity for stirring. In the Gironde the vats are filled to a certain point; if the stalks have been separated they are placed on the top of the murk, the house is shut, and fermentation allowed to complete itself. The top of stalks is now taken off, together with the outer layer of murk, which is mostly somewhat decomposed. But the bulk of the murk is now submerged and stirred with the new wine, so that its colour may be fully extracted. At last the wine is drawn off and the murk put in the press. In other parts the husks of red must are kept submerged in the fluid by a wooden cover fixed somewhat under the level of the fluid, and pierced with holes to allow the gas to escape. In other districts again the vats are covered, but opened daily, and the murk is submerged with wooden instruments. In parts of Burgundy the vats are not covered, nor is the murk stirred before fermentation is complete. At that period, however, the mixture receives an energetic stirring by men, who enter the vats quite naked and work about in the mixture with body and limbs. This most objectionable practice is now happily on the decline. When the fermentation of the red wine is complete, the liquid is put into barrels and allowed to settle. It clears much quicker than the white wine, which remains thick for weeks when fermenting in the temperate atmosphere of northern districts. But the red wine, having been fermented in larger bulk, attains a higher temperature, and therefore is finished in a shorter period. In southern parts, where there are mostly no cellars, the white wine, if it is allowed, completes its fermentation as quickly as the red. The only means available in those parts to slacken fermentation is the placing of the wine in stone vats, which, by conducting heat better than wood, effect a reduction of temperature of the must, and thereby retard fermentation.

When the wine has completed its fermentation and become clear, all the yeast and impurity are deposited in the bottom of the cask. From this the wine has to be separated by the process called "racking." This can be done by drawing the wine through a syphon placed in the bunghole, or through a tap fixed in the most suitable place. The clear wine is put into a clean cask; the cask just emptied is freed of its lees, washed and rinsed, and is immediately ready to receive the clear wine from another cask to be racked. By this operation the wine generally becomes disturbed a little, or it is not yet quite clear, and in any case requires fining. This is mostly done by means of isinglass, of which a small quantity is soaked in wine until soft, and then stirred with the contents of a cask. All casks thus treated are made bung-full, closed, and allowed to rest for six weeks. After this period the wine is mostly quite clear and bright, and being racked another time mostly remains so. In this state the wine is kept in the cellar or shed (*chais*) until ready for sale, use, or bottling.

PRODUCTION OF WINE BY THE PROCESS OF PETIOT.

In 1852, Petiot caused a quantity of black grapes, which by pressing would have given 60 hectolitres of wine, to be crushed, and 45 hectolitres of the juice, which ran off before it had time to ferment, to be collected. He mixed this with an equal quantity of sugar-solution, which contained the same amount of sugar as the must. This mixture of equal parts of grape-juice and sugar-water yielded him a very good wine. To the pulp of the grapes which remained behind, Petiot added 50 hectolitres of sugar-solution containing 18 per cent. of sugar. The mixture fermented immediately, and was finished in three days; and 50 hectolitres of wine of a nice colour were drawn. Pleased with the quality of his product, Petiot determined to exhaust the murk to the utmost. He repeated the process twice more, each time with 55 hectolitres of sugar-solution containing 22 to 23 per cent. of sugar. At last he made a fifth experiment by mixing the murk which had been pressed with 45 hectolitres of sugar-solution of equal concentration as before. From a quantity of grapes which, according to the ordinary proceeding, would have yielded only 60 hectolitres of wine, there were obtained, by the aid of 240 hectolitres of sugar-solution, on the whole 90 hectolitres of white, and 195 hectolitres of red wine—altogether, therefore, 285 hectolitres of wine,—as Petiot says, "wine in the full sense of the word." It was therefore certain that the many matters which are contained in the grapes, or some of them, and which are not extracted with the must, are capable of passing into a large quantity of sugar-solution when it is brought into contact with the grapes or their residues, and of transforming it into wine. These experiments were witnessed by the celebrated chemists Thénard, father and son, who were neighbours of Petiot. Thénard was in the year 1855 prevailed upon to treat the whole of his vintage produce according to this method; and he obtained from a quantity of grapes, which according to the ordinary proceeding would have given him 500 hectolitres of wine, 2,000 hectolitres, the quality of which gave general satisfaction.

Of the infusions of sugar-solution which Petiot made in 1854, the third gave the strongest coloured product. In the year 1855 the whole of the colouring matter of the grapes was already exhausted by two infusions. The new wine is less acid and more drinkable; it has more bouquet than the wine which is made from the grapes directly. It has an extraordinary power of lasting. In June he took several bottles and put them in a warm place in the kitchen. Here they were left standing upright—part of them without corks—for three months; and while he caused several persons to taste of them from time to time till they were gradually emptied, the wine did not become worse, and remained clear and without taste of acid to the end. He sent a sample of this wine to New Orleans, where it arrived in perfect condition.

Although the factitious wine contains probably a somewhat larger quantity of unchanged sugar, which gives it a more agreeable taste, yet it does not again pass into fermentation, because it does not contain any fermentescible albuminous matter. The white variety requires a little more time for clearing, because the yeast is not sufficient to decompose all the sugar very quickly; but once clear, it never becomes turbid again.

The best grapes or finest growths, when treated according to Petiot's process, yield the greatest advantages; for that which remains best to the very end of the operation is the bouquet—the particular flavour which distinguishes each situation and each product, and which gives it its value. Many persons have tasted these wines, have found them good, and have not been able to distinguish them from the wines pressed from the grapes directly, and yet they cost but one-third of the price of the latter. Such are the data which Petiot published in a letter addressed to the Central Society of Agriculture.

This method was introduced into Germany by Thilmany, General Secretary of the Agricultural Society of Rhenish Prussia, who made experiments with the process, in order to be able to determine its value by personal experience. In the year 1858 he related his experience before a meeting at Bonn. A report of this lecture is given in the *Bonner Zeitung* of March 5, 1858. His lecture bore the title, "On the French art of making, from a given quantity of grapes, four times the quantity of wine which those grapes would yield by the ordinary method." He exhibited a great number of samples of wines made by this method. The circumstance that Thénard had then also used this new method, and had employed in his experiment thirty-six thousand kilogrammes, of a value of eleven thousand thalers, of sugar—a sum of money which such a man would not easily risk unless he felt sure of the success of his process—came greatly in aid of the lecturer.

Dr. L. Gall of Trêves, who had already taken up this matter some years before Petiot, now published in the year 1862 a little pamphlet entitled "Petiot's Method of increasing the Quantity of Wine" (Trêves). He gave in that pamphlet a series of tables by which every producer might at a glance ascertain the quantity of water and sugar which he would have to add to the murk of the grapes in lieu of the natural must withdrawn. He then adduced in support of the process the teachings of the French chemist Mauméné of Rheims, and of Ladrey of Douay in Burgundy. Mauméné's "Sur le Travail des Vins" gives an historical account of experiments which were made in the year 1777 by the celebrated chemist Macquer, who from quite unripe and hard grapes made an agreeable tasting, fiery wine, like that from ripe grapes. He says that the experiments of Macquer have been changed a thousand times, and have been employed by thousands of people, without ever having been studied with scientific precision by any one until Petiot placed the matter clearly before the public. What must surprise every one is that each one of these chemists and experimenters admits that the sugar-infusion wines retain the perfect bouquet of the natural ones. The amount of acidity or of tartrate of potash in them is less than in the natural wines. The circumstance that they contain so little tartrate makes them much more like old wines, for it is well known that wines by age deposit their tartar and become milder to the taste. The infusion wines resemble natural wines in all essential qualities; they contain all the essential ingredients, and almost in the same proportions, as the natural product. The non-essential ingredients, or those which are frequently hurtful to the natural wines, are diminished in the infused wines to such an extent that their absence is a favourable circumstance. The method promises to increase the quantity of cheap beverage, and affords to the less opulent classes the means of making for themselves a cheap, wholesome beverage, even from grapes from which wines could not be obtained fit for commerce or transport.

SPECIAL APPARATUS AND RULES REQUIRED FOR THE PRODUCTION OF SUGAR-SOLUTION WINES.

1. Balance with weights. 2. Measuring vessels. 3. Vats admitting of the measurement of large quantities of fluid. 4. A hatchet for chopping the lumps of sugar. 5. A large copper kettle for producing sugar-solutions. 6. Froth spoons and ladles. 7. A thermometer centi-graduated according to Celsius. 8. A specific gravimeter. 9. A fermentation barrel with a pierced double bottom for drawing the wine from the murk.

The sugar must always be pure white cane-sugar, for grape-sugar so called, or sugar made by the influence of sulphuric acid upon starch, is always objectionable. Cane-sugar is always chemically pure, while grape-sugar is frequently moist and impure, though white. For every aum of sugar wine, which is equal to 160 bottles, from 40 to 50 lbs. of sugar are required.

The white grapes to be used should be left on the vine as long as possible, for it is known that their quality becomes the better the longer they are allowed to hang; the quantity of sugar contained in them increases, while the amount of acid diminishes. The black grapes, on the contrary, should not be allowed to get over-ripe, for the wines obtained from over-ripe black grapes mature very quickly, and, indeed, are passed in the third year; while the red wines obtained from grapes at the proper stage of ripeness have their greatest value from the second to the fourth year, or as long as they possess the qualities of youth.

The grapes may be pressed, and the murk treated with the sugar-solution; or the grapes may be crushed and fermented together with their juice, and the first wine drawn off after they have fully fermented, and the sugar-solution thrown upon the murk. All this depends upon the nature of the grapes, and the amount and quality of the wine which the producer wants to obtain. In any case he adds to the murk always a quantity of sugar-solution, which is the same as the amount of the must withdrawn, and contains the same amount of sugar. This process allows of any person obtaining a large quantity of wine without sacrificing a single drop of his natural wine; for he, of course, obtains the natural wine in the first instance, and can deal with it as he pleases.

ADJUSTMENT OF ACIDITY AND SUGAR WHICH OUGHT TO BE MADE IN MUST BEFORE IT IS ALLOWED TO FERMENT.

A wine which contains less than 6 per cent. of alcohol tastes flat, and a wine with more than 10 per thousand of acid is so sour that one cannot drink it. Now, if we obtain in a bad year a must which contains only 12 to 14 per cent. of sugar, and from 15 to 18 per thousand of acid, we are obliged to throw away the wine which would be obtained from such a must, for nobody could drink it; it has, indeed, been demanded by many persons that such produce should be thrown away. But without entering into the discussions which have been held on this subject, we ourselves have come to the conclusion that it would not be prudent to propose, and impossible to enforce, such a measure. Various processes have been devised to improve such a wine. The first process was invented by Chaptal: he merely added the sugar which was wanted, and thereby gave it more strength, but he did not by any means diminish the acid; and that diminution of acid was in France and other parts generally effected by the addition of chalk or plaster of Paris containing chalk. It was Dr. Gall, whom we have already quoted in a former paragraph, who first proposed to dilute acid must with a sufficient quantity of water, in order to reduce the proportion of its acid to that of the best natural must, and then to add sugar in order to bring up its sweetness to that of the best natural must. Gall determined the amount of acid in the must by chemical analysis, and then depressed its quantity to an average of 5 per thousand. The addition of sugar was made sufficiently great to be equal to 20 per cent. of the diluted must. To express the proceeding of Gall shortly, he made in all cases a normal must of 20 per cent. of sugar and 5 per thousand of acid. Of course the quantity of wine thus produced was the greater, the greater had been the acidity in the must employed ; but what struck the observer as most remarkable was this circumstance, that the wine was always better than the wine from the same sour must made by ordinary means. Indeed, anybody who will consult old cookery books will find therein numbers of prescriptions for making gooseberry, currant, and all sorts of fruit wines, and he will find in all of them that water is added to the fruit-juices, and then their sweetness brought up to a certain point before they are allowed to ferment. The process of Gall was therefore only an extension to wine must of a practice which for a very great length of time had been commonly applied to ordinary fruit-wine. We have ourselves made several descriptions of fruit-wine according to this process, in the following manner.

DESCRIPTION OF THE PROCEEDINGS FOR MAKING FRUIT OR GRAPE WINES, ACCORDING TO THE METHOD OF GALL.

The fruit is well crushed and the juice pressed out. A small quantity of that juice is then analysed as to its acidity. A standard solution containing 5 parts of tartaric acid in one litre of solution is made ; a saturated solution of lime in water is made, on the other hand ; and it is ascertained by the usual method of volumetric analysis how many cubic centimetres of the lime-water are necessary to neutralize a given quantity—say ten cubic centimetres—of the tartaric acid solution. By this means it is found that a certain number of cubic centimetres of the lime solution correspond to a certain quantity of tartaric acid; or, if applied to any liquid containing an unknown amount of acid, they will express the quantity of acid contained in that liquid as tartaric acid. Now, when we took a natural fruit-juice, and found say 10 per thousand of acid, we were obliged to add to every five measures of the juice five measures of water, whereupon the acidity would be depressed to half its original degree, or 5 per thousand. When we found 12 per thousand, and were desirous to reduce the quantity of acid to 7 per thousand—which we always did in cases where we supposed the acid present to consist more of citric and malic than of tartaric acid—we added to every seven measures of must five measures of water. Our practice, therefore, yielded the following rule: The quantity per thousand of acid which it is desired to obtain is deducted from the quantity per thousand actually found by analysis; the remainder gives the number of measures of water which it is necessary to add to the measures of must, expressed by the desired quantity of acid per thousand. By this dilution the quantity of sugar is naturally very much depressed; but as this depression is known, it can be easily remedied. The specific gravity of the must, according to the tables, gives the quantity of sugar which is actually contained in the mixture. Suppose the sugar originally contained in a fluid so diluted had been 15 per cent., and the quantity of fluid had been raised from 5 to 10 measures, then the percentage of sugar after the dilution is $15 \times \frac{5}{10} = 7\frac{1}{2}$ per cent. In the second case, where, as above mentioned, we have diluted from 7 to 12 measures, the equation would be—

$$15 \times \frac{7}{12} = 8\frac{3}{4} \text{ per cent.}$$

Now if it is desired to bring up the must to the normal strength, 20 per cent. of sugar, then, in the first case, there would have to be added 20 less $7\frac{1}{2}$, or $12\frac{1}{2}$ per cent. of sugar; and in the second case, 20 less $8\frac{3}{4}$, or $11\frac{1}{4}$ per cent. of sugar.

One per cent. of 100 litres must is equal to 1 kilogramme: 100 litres of dilute must require therefore $12\frac{1}{2}$ and $11\frac{1}{4}$ kilogrammes of sugar. The wines obtained from these mixtures contain 5 per thousand of acid, and between 10 and 11 per cent. of alcohol.

PLASTERING OF WINE AND MUST.

It is a very common practice in Spain, Portugal, and the south of France, to add plaster of Paris to the grape-juice in the process of wine-making. The plaster is either thrown upon the grapes before they are crushed, or it is added after fermentation has commenced.

The reason generally given in favour of such addition of plaster of Paris is that the plaster, by uniting with some of the water of the grape-juice, renders the remaining juice richer in sugar, and therefore more valuable. If such be really the intention, the desired effect will not be obtained to any degree worth noticing, because even perfectly pure and anhydrous plaster of Paris unites with only a little more than one-fourth its weight of water, while the gypsum thus formed takes up mechanically a considerable quantity of liquor, and thereby greatly reduces the yield. In order to prove this, we have made the following experiments.

The juice experimented upon was pressed from grapes imported into the London market as Lisbon grapes, 48 oz. of which yielded 32 oz. of juice. Two ounces of juice being reserved for examination by itself, the rest was divided into three quantities of 10 oz. each, to which were added 1, 2, and 5 oz. of plaster of Paris respectively, or 10, 20, and 50 per cent. The plaster of Paris was added in small quantities, well stirred into the juice, and allowed to remain in contact with it for twenty-four hours. The clear juice was then poured off the precipitate, and the latter placed upon a cloth and pressed, so as to obtain as much juice as possible. The portion to which 50 per cent. had been added had quite solidified, so that no juice could be obtained without pressing.

In this manner 9 oz., 8 oz., and 4·3 oz. of juice were recovered of the 10 taken in each case. The original juice and the three samples treated were then examined for sugar, free acid, and in two cases for tartaric acid and ash. The results are given in the following tables, the figures showing the amount of substance present in grammes in 1 litre of juice :—

Juice.	Sugar.	Free acid calculated as T.
Original juice contained	137·58 grms.	5·07 grms.
Juice treated with 10 per cent. plaster, 90 per cent. recovered	138·38 ,,	4·57 ,,
Juice treated with 20 per cent. plaster, 80 per cent. recovered	143·96 ,,	3·35 ,,
Juice treated with 50 per cent. plaster, 43 per cent. recovered	154·54 ,,	0·66 ,,

It will be seen from these data that the addition of plaster increases the percentage of sugar but diminishes the amount of juice. Taking both effects into consideration, we arrive at the following calculation :—

Amount of sugar in 1 litre juice	137·58 grms.
Amount of sugar in juice recovered from 1 litre after the addition of 10 per cent. plaster	125·44 ,,
Amount of sugar in juice recovered from 1 litre after the addition of 20 per cent. plaster	115·16 ,,
Amount of sugar in juice recovered from 1 litre after the addition of 50 per cent. plaster	66·45 ,,

In the last case therefore more than half the sugar in the original juice had to be abandoned, in order to raise the percentage of the remainder from 13·75 to 15·45. The same effect might have been produced by the addition of 2 per cent. of sugar, or by the evaporation of 11·1 per cent. of water. In the first case, 2 per cent. more juice would have resulted, and in the second case a loss of only 11·1 per cent., against 57 per cent. loss by the use of plaster of Paris, for the same increase in the amount of sugar, viz. 2 per cent.

From the above we may conclude that plaster of Paris added to grape-juice combines chemically with one-fourth of its weight of water, the gypsum so formed absorbing its own weight of juice, which cannot be recovered by pressing. Nor is this effect altered if the gypsum be allowed to ferment with the must, the only difference being that whereas in the first case the gypsum retains must, in the latter case wine remains absorbed, the relative loss being as great as before.

Diminution of yield is, however, not the only drawback connected with the plastering of wine. The gypsum decomposes the tartrate of potassium present in the juice, insoluble tartrate of calcium being formed, and sulphate of potassium going into solution. At the same time the carbonate of calcium, always present in larger or smaller quantities in plaster of Paris, precipitates the free tartaric acid. It neutralizes some of the other free acids of the juice, and if present in sufficient quantity, it neutralizes them completely, in which case the phosphates of the juice will also be precipitated.

The addition of plaster of Paris therefore tends to the more or less complete removal of the tartaric acid, one of the most characteristic constituents of grape-juice, leaving only free or combined malic acid, an acid which grapes have in common with all other sour fruit. The place of cream of tartar is taken by sulphate of potassium, a salt having a perceptibly bitter taste, and acting as a purgative even in moderate doses.

Moreover, as it appears that the amount of tartaric acid increases with the increasing ripeness of the grape, while the malic acid diminishes, the plastering virtually reduces the juice of even the ripest grapes to a state of unripeness, at least as regards the nature of the acids. In the samples analysed, as above, the tartaric acid present in the original juice amounted to 0·916 grms. per litre ; in the sample treated with 20 per cent. plaster it had been reduced to 0·01 grm., the amount of malic acid remaining the same. The original juice yielded 4·085 grms. ash per litre, containing 2·415 grms. carbonate of potassium, while the sample treated with 20 per cent. of plaster yielded 7·255 grms. ash, containing 0·005 grm. carbonate of potassium.

The experiments made with juice with which the plaster of Paris had been allowed to ferment completely confirm the results of the former analyses.

Three quantities of grapes of 20 oz. each were taken, crushed in a mortar, and then put into a flask closed by a mercury valve, so as to allow the escape of carbonic acid, and prevent the free entry of atmospheric air. One sample (No. 1) was allowed to ferment by itself; to another sample (No. 2) 1 oz. of plaster was added before fermentation; and 2 oz. of plaster were added to No. 3 sample, also before fermentation,—or 5 per cent. and 10 per cent. respectively. After fermentation they were analysed, and any sugar yet unfermented was calculated as yielding its equivalent of alcohol, and the amount added to the alcohol found. The amounts of tartaric acid, ash, and carbonate of potassium in the ash were also estimated.

The juice, before fermentation, contained 14·0 per cent. sugar, and 0·236 per cent. tartaric acid. It left 0·39 per cent. ash, containing 0·207 per cent. carbonate of potassium.

No. 1 yielded, on pressing, juice equal to 78·75 per cent. of the weight of grapes taken, and contained 6·12 per cent. alcohol, 0·208 per cent. tartaric acid, and left 0·343 per cent. ash, with 0·138 per cent. carbonate of potassium.

No. 2 yielded, on pressing, 76·25 per cent. juice, containing 6·17 per cent. alcohol, 0·090 per cent. tartaric acid, and left 0·603 per cent. ash, containing 0·013 per cent. carbonate of potassium.

No. 3 yielded, on pressing, 71·25 per cent. juice, containing 6·36 per cent. alcohol, 0·071 per cent. tartaric acid, and left 0·620 per cent. ash, containing 0·013 per cent. carbonate of potassium.

Taking the yield of No. 1 (grape-juice without any addition) as 100, with 6·12 parts of alcohol, the yield of No. 2 will be 96·82 with 5·97 alcohol, and No. 3 90·4 with 5·75 alcohol, showing a loss of alcohol in No. 2 of 2·5 per cent. of yield of No. 1, and of 6 per cent. of yield of No. 1 in No. 3.

The increase of ash in Nos. 2 and 3 is due chiefly to the conversion of carbonate of potassium into sulphate of potassium, and partly to the solubility of the plaster of Paris.

As in Spain, Portugal, and the south of France plaster of Paris is very generally added to the grapes, it has been presumed that this process must be of use, and we therefore think it unsafe to draw the conclusion from our experiments which naturally suggests itself, viz. that plastering is of necessity only hurtful and disadvantageous to the wine and the producer. But this result of our analysis is unquestionable, namely, that the ordinarily stated object of the practice, viz. that it withdraws water, and thereby effects a condensation of the must, is not the real object.

In some breweries plaster of Paris is employed for the pre-precipitation of certain albuminous matters which have a tendency to affect the beer in an unfavourable manner, and in some sugar refineries it is used for analogous purposes. It remains to be seen whether a similar object is attained by plastering in the case of wine. But even in that case the practice would be rendered superfluous by the subsequent brandying of this wine, which puts a stop to all further changes.

CHAPTER V.

CHEMISTRY OF ALCOHOL.

Physical characters of alcohol.—Elementary constitution and chemical characters of alcohol and its homologues.—Methods of alcohol determination based upon the specific gravity of alcoholic mixtures.—Distillation.—Determination of the specific gravity of the alcohol by indirect means.—Methods of alcohol determination based upon the boiling point of alcoholic mixtures.—The ebullioscope.—Geisler's instrument.—Vaporimeter.—Silbermann's dilatometer.—*Résumé*.—Experiments on the state in which alcohol is contained in wine.

PHYSICAL CHARACTERS OF ALCOHOL.

GRAPE-SUGAR, under the influence of vinous fermentation, undergoes a change, the main products of which are alcohol and carbonic acid. This transformation is represented by the following chemical formula :—

$$\underset{\text{Grape-sugar.}}{C_6 H_{12} O_6} = \underset{\text{Alcohol.}}{2 C_2 H_6 O} + \underset{\text{Carbonic anhydride.}}{2 C O_2}.$$

Besides these two principal products, there are, however, always formed greater or smaller proportions of several other substances, closely allied in chemical character to alcohol properly so called, and hence termed homologous alcohols, and a certain amount of glycerine and succinic acid.

To obtain the pure alcohol, the fermented liquid is submitted to repeated fractional distillation; the distillate is rectified over charcoal, or filtered repeatedly through fresh charcoal, and then again distilled. By these means the greater part of the water and of the other admixtures are removed. The strong spirit (rectified spirit) so obtained is next shaken up with a quantity of dry carbonate of potassium. After standing for some time, the mixture separates into two layers, of which the lower one consists of a concentrated aqueous solution of potassium carbonate, while the upper one is nearly anhydrous alcohol. This upper layer is taken off by a syphon or pipette, and, finally, repeatedly distilled over freshly burnt quicklime, to remove the last traces of moisture.

The alcohol thus obtained is generally distinguished as absolute alcohol; it is a colourless, very mobile liquid, of a peculiar spirituous smell and extremely burning taste; it is poisonous even in small doses. It has a specific gravity of 0·791 at 20, and 0·793 at 17·5 Meissner; 0·7925 at 18 Dumas and Boullay; 0·7996 at 15 Kopp; 0·7938 at 15·5 and 0·790 at 20 Connel; 0·7938 at 15·5 Fownes; 0·80625 at 0, 0·79788 at 10, 0·79367 at 15, 0·78945 at 20, and 0·78096 at 30, water at 4° C. taken as 1, Mendelegeff; 0·79792 at 10, 0·79317 at 15·5, 0·78932 at 20, water at 4° C. taken as 1, Dupré and Page.

It boils at	78·41	with a pressure of		760^{mm}	Gay Lussac.
,,	76·	,,	,,	745^{mm}	Dumas and Boullay.
,,	78·303	,,	,,		Mendelegeff.
,,	77·89	,,	,,	744·4^{mm}	Dupré and Page.

It does not solidify at the lowest temperature obtainable (− 150° C.), though it becomes somewhat viscid. Its specific heat is 0·615 Kopp; 0·601 between 15 and 10 Regnault; 0·60430 between 17 and 21 Dupré and Page. The expansion by heat is almost exactly proportional to the temperature, and when heated from zero to 78·4, it expands 0·0936 parts of its volume at zero. The capillary attraction is 39·21, water being 100. Compressibility for one atmosphere at 9·7° C. 0·00009349. It is readily inflammable, and burns with a pale blue non-luminous flame. It is miscible with water in every proportion. Its admixture with water is attended with evolution of heat and contraction of volume; the mixture has a higher temperature and occupies a smaller bulk than the water and alcohol separately possessed. The amount of heat produced, and the contraction taking place, differ with different proportions of alcohol and water: the heat is greatest when thirty parts by weight of alcohol are mixed with seventy parts of water, in which case the temperature of the mixture rises 9·14° C. and 47·98 units of heat are evolved by

5 grms. of mixture, Dupré and Page (*Philos. Trans.* 1869, p. 605); the contraction is greatest when 53·939 vol. of alcohol are mixed with 49·836 vol. of water, when it amounts to 3·638 per cent. the 103·775 vol. of water and alcohol become reduced (after cooling of the mixture to the original temperature) to 100, or 100 vol. become 96·362 vol. On account of this contraction varying with different mixtures, it was impossible to calculate the specific gravity of any mixture from that of its constituents, and it had, in consequence, to be determined experimentally.

In these mixtures the specific gravity, the boiling-point, and capillary attraction fall, the rate of expansion and the vapour tension rise, with the increasing percentage of alcohol; and hence these properties may be made use of for estimating the amount of alcohol present in a mixture of alcohol and water.

The specific heat and compressibility of these mixtures show a remarkable peculiarity. Although, as above given, the specific heat of alcohol is considerably less than that of water, yet mixtures of alcohol and water containing from 1 to 35 per cent. of alcohol have a higher specific heat than water itself (Dupré and Page); at an alcoholic strength of about 36 per cent. by weight the specific heat is equal to that of water, and continues below that of water with the increase of alcohol up to absolute alcohol, although throughout it is higher than the mean specific heat of its constituents. It follows that up to an alcoholic strength of 36 per cent. two mixtures may always be found having the same specific heat, and this property cannot therefore be made use of for estimating the strength of mixtures weaker than this. The compressibility shows just the opposite progression. The addition of little alcohol to water causes the compressibility of the mixture to be less than that of water; at an alcoholic strength of about 50 per cent. it reaches that of water, continuing thence greater until in absolute alcohol it reaches almost twice this amount. Therefore, below a strength of 50° two mixtures may always be found showing the same compressibility.

If spirit of wine, of whatever strength, is put into a tube one end of which is closed by an animal membrane, while the other end is open, and this tube is then immersed in pure water, so that the surfaces of the liquids in and outside the tube are on a level, it will be observed, after a short lapse of time, that the liquid inside the tube rises. If the water outside is from time to time renewed, and the tube is gradually dipped deeper into the water, so as to keep the inner and outer liquid always on a level, the rise of the liquid in the tube will become slower, and at last cease altogether. If now the contents of the tube be examined, they will be found to consist of pure water only, but there will be considerably more water than there was water and alcohol in the tube at the beginning of the experiment. This phenomenon, called Exosmosis and Endosmosis, consists therefore in the passage of alcohol out of the tube, and the passage of water into the tube. The animal membrane, however, allows more water than alcohol to pass in a given time, in consequence of which the liquid, on that side of the membrane on which the alcohol is, increases in bulk. In other words, if an animal membrane separates alcohol from water, or a stronger from a weaker spirit, an interchange of liquid will take place through such membrane until the composition of the mixture on both sides is equal, the alcohol or stronger mixture losing in alcohol, but gaining in bulk; the water or weaker spirit gaining in alcohol, but losing in bulk: the exchange taking place, generally speaking, the more rapidly the greater the difference in alcoholic strength on the two sides of the diaphragm, so that this property may even be made use of for estimating the strength of a mixture. If, as in the experiment above described, the liquid on one side of the membrane is always pure water, all the alcohol will, as stated, find its way out, and the interchange will only cease when nothing but pure water remains. Under these circumstances it has been found that the proportion between the alcohol passing the membrane in one direction, and of the water passing in the other, although varying with different membranes, is constant for one and the same membrane, and is independent of the strength or amount of spirit used, and is but slightly variable with the temperature. This proportion, or rather the amount of water passing in for one gramme of a substance passing out (for this endosmosis and exosmosis takes place not only between alcohol and water, but between water and all substances, liquid or solid, soluble in water) through the membrane, is called the endosmotic equivalent: it is for alcohol, according to Jolly, in the case of pig's bladder, 4·13; that is, for every gramme of alcohol passing through the pig's bladder into the vessel holding the water 4·13 grms. water will have passed through the bladder into the vessel holding the spirit, by the time when all interchange has stopped, and only pure water is contained in the apparatus. Soemmering's method for procuring strong alcohol is based upon the same property. It consists in putting a weak spirit into a bladder from the calf or ox, and hanging it up in a warm place for some time. Both alcohol and water pass through the bladder, and evaporate on the outside; but as considerably more water than alcohol passes through, the alcoholic strength of the liquid in the bladder increases, and it is said that even absolute alcohol may thus be obtained, more particularly if the bladder, before use, be covered inside and out with a thin coating of isinglass.

ELEMENTARY CONSTITUTION AND CHEMICAL CHARACTER OF ALCOHOL AND ITS HOMOLOGUES.

As above stated, alcohol and carbonic anhydride, although the chief, are not the only products of vinous fermentation, but there are always produced a greater or lesser amount of various other substances, among which are a number closely resembling alcohol in chemical character. The use of the term alcohol has therefore been extended so as to include all these allied bodies. If, however, the term alcohol is used by itself, ordinary or ethylic alcohol is meant.

These alcohols are compounds of carbon, hydrogen, and oxygen. In some of their chemical characters they bear a strong resemblance to water, and may, therefore, be looked upon as water in which one atom of hydrogen has been replaced by a compound radicle. The most simple of these radicles is called methyl, and has the composition CH_3. It is the type of a so-called homologous series of radicles, which become progressively more complicated than the type, every succeeding member having one atom of carbon and two atoms of hydrogen, or CH_2, more than the preceding. The members of this series resemble each other in character the more the nearer they stand to each other in the series. The higher members may be viewed as methyl, in which one or more atoms of hydrogen have been substituted by methyl or its homologues.

Thus we have the series :—

Methyl, $C\,H_3$.

Ethyl, $C_2\,H_5$ or $(C\,H_2, C\,H_3)$.

Propyl, $C_3\,H_7$ or $(C\,H_2, C_2\,H_5) = C\,H_2\,(C\,H_2, C\,H_3)$ or $C\,H\,(C\,H_3, C\,H_3)$.

Butyl, $C_4\,H_9$ or $C\,H_2\,(C_3\,H_7) = C\,H_2\left[C\,H_2\,(C\,H_2\,(C\,H_3))\right]$ or
$C\,H_2\left[C\,H\,(C\,H_3, C\,H_3)\right]$ or $C\,H\left[C\,H_2\,(C\,H_3, C\,H_3)\right]$ or
$C\left[(C\,H_3, C\,H_3, C\,H_3)\right]$.

Amyl, $C_5\,H_{11}$.

Caproyl, $C_6\,H_{13}$.

As will be observed, only one ethyl is possible, one of the atoms of hydrogen in methyl being replaced by methyl. Of propyl, however, two isomers are possible, one in which one atom of hydrogen is replaced by ethyl, and another in which two atoms of hydrogen are replaced by two methyl. Butyl, in similar manner, admits of four isomers, amyl of eight. And thus the number of possible isomers rises in an arithmetical progression. In ethyl we have thus only one of the hydrogen atoms of the methyl substituted; in the case of propyl, we may have either one or two thus replaced, whilst in butyl and all the radicles higher in the series we may have one, two, or all three thus replaced. Radicles formed by the substitution of only one atom of hydrogen in methyl are termed primary radicles; when two are thus replaced, secondary radicles; and if all three are replaced, tertiary radicles. There is thus only a primary ethyl; there are a primary and secondary propyl; while all the higher radicles may be not only primary, secondary, or tertiary, but there may be even several isomeric representatives of each of these.

If these radicles form alcohols, we obtain corresponding primary, secondary, and tertiary alcohols. Primary alcohols in which the replacing radicle has the general formula $C_2H_3\ (CH_2)_n$, formed like ethyl by the substitution of one atom of hydrogen in methyl by the next lower radicle of corresponding structure, as

$C\ H_3,\ H\ O$, methylic alcohol.

$C\ H_2,\ C\ H_3,\ HO$, ethylic alcohol.

$C\ H_2,\ C_2\ H_5,\ H\ O$ or $C\ H_2\ (C\ H_2,\ C\ H_3)\ H\ O$, propylic alcohol.

$C\ H_2,\ C_3\ H_7,\ H\ O$ or $C\ H_2\ (C\ H_2,\ C\ H_2,\ C\ H_3)\ H\ O$, butylic alcohol, &c.

are called normal alcohols, all the other possible isomers are called pseudo-alcohols.

These primary alcohols have important powers of metamorphosis. The hydrogen of the water residue may be replaced by an acid radicle; the resulting compound is a so-called compound ether: thus

Ethylic alcohol.		Acetic acid.		Acetic ether.		Water.
$C_2\ H_5,\ H\ O$	and	$C_2\ H_3\ O,\ H\ O$	yield	$C_2\ H_5,\ C_2\ H_3\ O,\ O$	and	$H_2\ O$.

Or some of the hydrogen of the alcohol may be abstracted (by combining it with oxygen), the result being aldehyde and water: thus

Ethylic alcohol.		Ethylic aldehyde.		Water.
$C_2\ H_5,\ H\ O + O$	=	$C_2\ H_3,\ H\ O$	+	$H_2\ O$.

Under the continued influence of oxidizing agents upon aldehyde the place of the abstracted hydrogen is taken by one atom of oxygen, the result being a monobasic acid:

Ethylic aldehyde.		Acetic acid.
$C_2\ H_3,\ H\ O + O$	=	$C_2\ H_3\ O,\ H\ O$.

Each primary alcohol has thus a corresponding aldehyde and acid. Only one primary ethylic and propylic alcohol existing, there is of course only one corresponding aldehyde and acid. The higher alcohols, however, may give rise to an aldehyde and an acid for each of the isomeric primary alcohols possible. The compounds mentioned in the foregoing summary are either found in wine as a rule, or may be found under certain circumstances, free or in combination. The radicle methyl occurs in trimethylamine, a strong base of the ammonia type present in many wines. The alcohol corresponding to this radicle, termed methylic alcohol or wood-spirit, is however not found in wine or in any other fermented liquid. Of the remaining alcohols, we have in wine besides the ethylic, which greatly predominates, propylic, butylic, amylic and caproic. The relations of these alcohols to the qualities of the wines are not yet sufficiently investigated. All the alcohols of this class in wine and in all other fermented liquids are primary ones, and generally, though not always, also normal. Of the several aldehydes, the ethylic and the propylic are now and then found in wines. Of the acids we find formic related to methylic alcohol, as acetic acid, a normal ingredient of wine, is to ethylic alcohol. Of propylic alcohol we may have not only the aldehyde, but also the acid, propionic acid. And of each of the higher members of the alcohol series we may have not only one but several primary forms, and of these forms the respective aldehydes and corresponding acids. Lastly, we may have compound ethers of all these alcohols and acids formed with the acids corresponding to their series, as well as compound ethers of all these alcohols with the other acids of the wine.

The foregoing will suffice to show that, even in regard to the alcohols alone, the possible varieties of wine must be almost infinite, and will also give some indication as to the difficulties to be encountered in fixing the character of a wine by chemical analysis alone.

DETERMINATION OF THE ALCOHOL OF WINE.

The various methods in use for the estimation of alcohol in wine have regard only to the ethylic alcohol. The proportion of the other homologous alcohols present is so minute, that any error committed by disregarding their presence is within the unavoidable errors otherwise incidental to the methods, and therefore unimportant.

Of the physical properties of alcoholic mixtures there are four which have chiefly been made use of, or have been proposed to be made use of, for estimating the amount of alcohol contained in them: namely, their specific gravity, their boiling-point, their vapour tension, and their rate of expansion. In alcoholic fluids, such as brandy, wine, or beer, the specific gravity of the mixture and its boiling-point fall with the increase in the amount of alcohol, while vapour tension and rate of expansion increase *pari passu* with the increase of the proportion of alcohol.

When we wish to ascertain the amount of alcohol in mixtures which contain no other ingredients but this and water, we have only to determine their specific gravity, and calculate the amount of alcohol from data which will be given further on. This method is, under such circumstances, at once the most accurate and the most expeditious. But when other substances are present in the mixture, they exercise, by their nature and quantity, an influence upon the specific gravity of the fluid ; and this function, therefore, ceases to be that of the alcohol only. Then it becomes necessary to separate the alcohol from these interfering agents, and to place it under circumstances where it may be mixed with water only. This is done by distillation, an operation requiring complicated apparatus, time, and attention. It was chiefly or solely with a view to saving the trouble and labour connected with this operation that other methods were devised, and no objections have ever been raised to distillation on the score of want of accuracy ; and, indeed, none of the other methods advanced has ever claimed superior or even equal accuracy with it.

We have, however, found that there is at least one method which gives very accurate results with less trouble than the process of distillation; and we have, therefore, accurately examined five of the chief methods which have any claim to scientific consideration. We have taken care to value the principle as well as the practicability of each process, and to distinguish between its general applicability and its special usefulness in given single cases.

METHODS OF ALCOHOL DETERMINATION BASED UPON THE SPECIFIC GRAVITY OF ALCOHOLIC MIXTURES.

There are two methods which are based upon this physical property.

According to the first method the alcohol is separated from the mixture by distillation, and the distillate is operated on for ascertaining the amount of alcohol, from which that in the original fluid, say wine, is easily determined.

According to the second method the amount of alcohol present in wine is calculated from the influence which it exercises upon its specific gravity.

DISTILLATION.

When this operation is conducted with the requisite care, it gives very accurate results. The quantity of wine used for the experiment should not be too small, but amount to from 200 to 300 cubic centimetres. It may be weighed, in which case the experiment becomes independent of temperature, and therefore the most accurate; or it may be measured, when the temperature of the sample has to be carefully ascertained. The weighed or measured quantity of wine is introduced into a flask or retort, rendered slightly alkaline by caustic soda, mixed with a small quantity of tannin to prevent frothing, and then carefully distilled by driving the alcoholic vapours, by means of heat applied underneath the flask, into a tube surrounded with cold water—a so-called condenser. It is well to drive over from one-half to two-thirds of the liquid in the flask. Strong and heavy wines may advantageously be diluted with water before distillation. The flask should be connected with the condenser in such a manner as to prevent any fluid from being projected over into the condenser. The condenser has to be kept well cooled; it should be connected, air-tight, with the receiver. The latter should be furnished with a safety tube—that is to say, a little glass tube, which is bent in the shape of a syphon, and at the lowest part of its bend contains a globule of mercury. This arrangement permits the air in the apparatus to expand and contract, and yet prevents almost entirely the otherwise unavoidable evaporation of alcohol during the progress of the distillation.

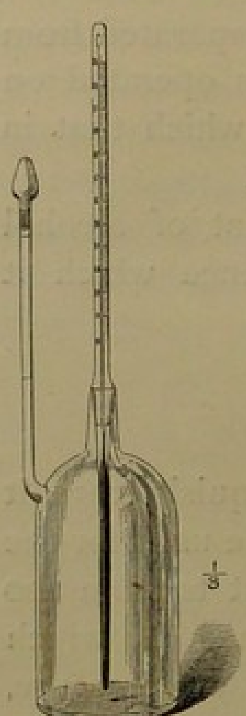


FIG 26.—Specific gravity bottle.

As soon as the necessary quantity is distilled, the distillate is mixed with so much water as may be required to raise it to the exact weight or measure of the wine originally taken for distillation. In the latter case, that of filling up to measure, the mixture must be brought to the same temperature as the original wine, and must be well shaken before being employed for the purpose of determining its specific gravity. This operation may be performed by a hydrometer, but it is better to employ the balance and specific gravity bottle. The specific gravity bottle should not be too small, and contain from 20 to 60 cubic centimetres. As the specific gravity of all fluids varies with the temperature, this has to be carefully noted. It is best so to manage the experiment that the fluid has the temperature of 15·5° C. or 60° F., the temperature for which most alcohol tables are constructed; and in case it should be either higher or lower, to cool it down or warm it up to the desired point. For variations of temperature which are not far removed from the standard calculated corrections may be applied without much trouble. The amount of such correction for each degree centigrade varies considerably with the strength of the spirit, and, though very slightly, with the glass of which the specific gravity bottle is made. In cases where the temperature differs only a few degrees either way from the mean, this correction can be

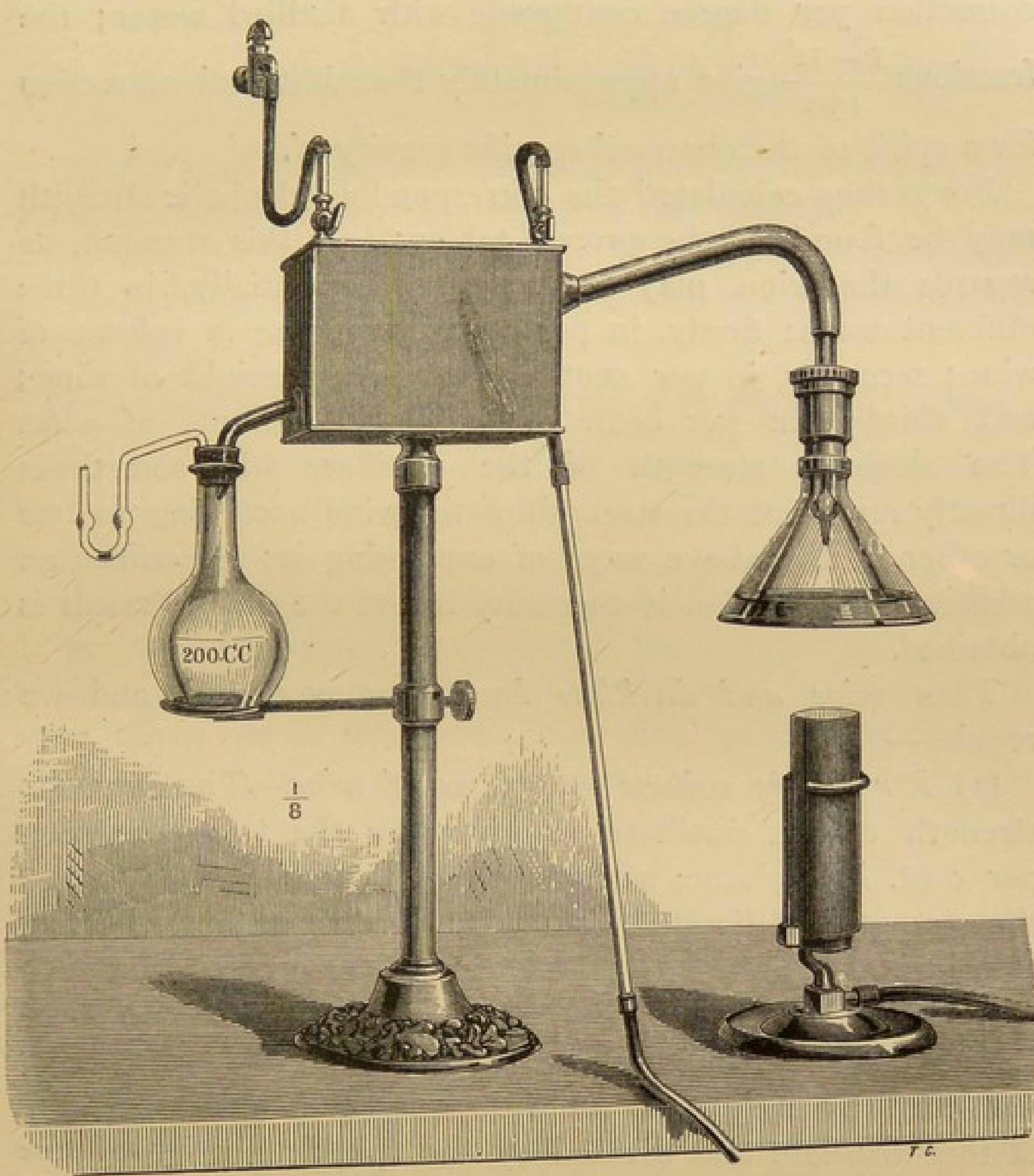


FIG. 27.—Apparatus employed for the distillation of wine. In the distilling vessel on the right is shown the arrangement used to prevent any spirting over of the wine, and on the extreme left the glass tube and mercury valve closing the receiver.

applied with sufficient accuracy by means of the following formula :—

$$D = D' + d\left(0{\cdot}00014 + \frac{1 - D'}{150}\right).$$

In this formula D is the required density at 15·5, D′ the density observed, and d the difference between 15·5 and the temperature at which D′ was taken. If this was below 15·5, the − sign is used; if above, the + sign. 0·00014 is the correction per degree centigrade with distilled water; the fractions $\frac{1 - D'}{150}$ give approximately the additional correction for a spirit of the observed specific gravity D′.

For D thus calculated the corresponding alcoholic strength may be found in the proper tables; and this strength, as regards the wine, may be expressed, essentially, in three different ways: firstly, in per cent. by volume in volume of wine; secondly, in per cent. by weight in weight of wine; and thirdly, in per cent. by weight in volume of wine. The alcoholic strength of the distillate will sometimes directly represent the strength of the wine according to one or other of the above ways of expressing it; sometimes an additional calculation is necessary before the desired result is obtained.

Thus *wine and distillate have been measured*, and we require—

(1) *Per cent. by volume in volume of wine.*—The alcoholic strength of the distillate, as given by the tables showing per cent. by volume, will at once give the desired result, the strength of distillate and wine as thus expressed being identical.

(2) *Per cent. by weight in weight of wine.*—The alcoholic strength of the distillate, according to the table giving per cent. by weight, is multiplied by the specific gravity of this distillate and divided by the specific gravity of the wine, or

$$\text{Per cent. by w. in w.} = \frac{\text{per cent. by w. of distillate} \times \text{by spec. gravity of dist.}}{\text{by specific gravity of wine.}}$$

(3) *Per cent. by weight in volume of wine.*—The percentage by weight of the distillate is multiplied by the specific gravity of such distillate—

$$\text{Per cent. by w. in vol.} = \text{per cent. by w. of dist.} \times \text{by spec. gravity of dist.}$$

Wine and distillate have been weighed, and we require—

(1) *Per cent. by volume in volume of wine.*—The percentage by volume of the distillate is multiplied by the specific gravity of the wine and divided by the specific gravity of the distillate—

$$\text{Per cent. by vol. in vol.} = \frac{\text{per cent. by vol. in vol. of dist.} \times \text{by spec. gravity of wine}}{\text{by specific gravity of dist.}}$$

(2) *Per cent. by weight in weight of wine.*—These are at once given by the percentage by weight of the distillate.

(3) *Per cent. by weight in volume of wine.*—The percentage by weight of the distillate is multiplied by the specific gravity of the wine—

$$\text{Per cent. by w. in vol.} = \text{per cent. by w. of dist.} \times \text{by specific gravity of wine.}$$

Wine has been measured, distillate weighed.—The percentage by weight of the distillate will give at once per cent. by weight in volume of wine.

The method of expressing the alcoholic strength of a wine in per cent. by weight in volume is the one adopted in our tables, and seems to us to be on the whole preferable to every other. If in this case the decimal point is moved one figure to the right, the number of grammes of alcohol contained in one litre of wine is obtained; and if this latter figure is further multiplied by 7, the number of grains of absolute alcohol in one gallon (6 bottles) of wine is given.

The English Excise has adopted a method of giving the alcoholic strength of wines or spirits differing from all the foregoing; namely, in volume per cent. of proof-spirit, indicated as degrees by Sykes' hydrometer. These are indicated directly by the specific gravity of the distillate, taken by balance or hydrometer, in case both wine and distillate have been measured.

In order to show that the above method is very accurate in its application, we give the following determinations of alcohol in mixtures of alcohol and water. Four samples of pure diluted spirit, differing in strength one from the other, were prepared; after the specific gravity of each had been carefully determined, 250 c.c. were subjected to distillation with the above described precautions. After the distillate had been brought up to 250 c. c. its specific gravity was taken. The following table represents the results of these operations :—

FIRST SAMPLE.

Specific gravity of original spirit,	972·49 ;	strength,	19·11	per cent.	b. w.
,, ,, distilled ,,	972·53 ;	,,	19·08	,,	b. w.

SECOND SAMPLE.

Specific gravity of original spirit,	978·74 ;	strength,	14·14	per cent.	b. w.
,, ,, distilled ,,	978·82 ;	,,	14·07	,,	b. w.

THIRD SAMPLE.

Specific gravity of original spirit,	984·55 ;	strength,	9·53	per cent.	b. w.
,, ,, distilled ,,	984·48 ;	,,	9·58	,,	b. w.

FOURTH SAMPLE.

Specific gravity of original spirit,	991·49 ;	strength,	4·82	per cent.	b. w.
,, ,, distilled ,,	991·49 ;	,,	4·82	,,	b. w.

It will be seen that the two specific gravities are always nearly identical, and differ no more than two separate estimations of the same mixture will frequently differ from each other. If, however, the receiver is kept open, and particularly if the distillate is allowed to drop through any distance, even inside the receiver, or runs down the sides of the receiver to any extent, a loss of 0·25 to 0·5 per cent. is generally experienced, which, by want of caution in other respects, may be increased to 2 per cent. and upwards.

DETERMINATION OF THE SPECIFIC GRAVITY OF THE ALCOHOL BY INDIRECT MEANS.

This method was first proposed by Tabarie, and afterwards much used and recommended by Balling and Mulder. It is based upon the following considerations. The presence of a certain amount of alcohol in a mixture will depress its specific gravity below what it would be if the alcohol contained in it were replaced by an equal proportion of water, and this depression will always be effected whether the mixture consists of water and alcohol only, or contains other substances in solution at the same time. Thus a solution containing 10 per cent. of cane-sugar, and 90 per cent. of water, has a specific gravity of 1040·4; the specific gravity of spirit containing 10 per cent. alcohol is 984·1; and a solution containing 10 per cent. sugar, 10 per cent. alcohol, and 80 per cent. water has a specific gravity of 1023·857.

$$1000 : 984{\cdot}1 = 1040{\cdot}4 : X.$$
$$X = 1023{\cdot}857.$$

If then, knowing the specific gravity of such a mixture, we expel the alcohol and replace it by water, and again take the specific gravity, we may calculate the specific gravity of a spirit containing the same percentage of alcohol as the mixture with the help of the following equation:—

$$D' : D = 1000 : X;$$

where D' is the specific gravity of the mixture deprived of alcohol, D the specific gravity of the mixture with the alcohol in it. In the above case the equation would show as follows:—

$$1040{\cdot}4 : 1023{\cdot}857 = 1000 : X.$$
$$X = 984{\cdot}1.$$

In practice, however, it is generally unnecessary to perform the above calculation, as the specific gravity can be obtained more easily, and with sufficient approximation to truth, according to the following equation (the letters of which have the same significance as those of the above formula):—

$$D + 1000 - D' = X.$$

This second formula is, however, inapplicable to wines containing much sugar or extractive, and which give a high value for D'. This may be illustrated by the case above given. X would be 983·45, as calculated by the second formula, instead of 984·1, the right value as calculated by the first. But as the method as a whole has a tendency to give the alcohol rather below than above its actual amount, the second expression gives generally the more accurate results.

The particulars of the process as applied to wine are the following. A certain measure or weight (100 c. c. or grammes) is carefully evaporated on a water-bath to about a quarter of its bulk; it is then cooled and mixed with sufficient distilled water again to bring up its weight or bulk to the original weight or bulk.

In all our experiments we have followed Tabarie's original method, *i.e.* measuring the wine and bringing the evaporated wine to the same measure by the addition of water. The specific gravity of the spirit calculated from the two data thus obtained we have assumed, with Tabarie, to represent the specific gravity of the distillate, when wine and distillate are measured. According to Balling's plan, however, the evaporated wine is brought to the same weight as the wine taken. The specific gravity of spirit calculated in this case is always slightly lower than that arrived at by the first process, and will therefore give a higher percentage of alcohol. Now as, with very few exceptions (chiefly among the sherries), the percentage of alcohol found by Tabarie's method is somewhat too low, it would appear that Balling's plan will give the more accurate results of the two, more particularly in case of all natural wines with no excessive proportion of sugar.

The operator so economizes his time, that whilst one portion is evaporating he takes the specific gravity of the wine itself upon another portion. As the necessary correction for temperature cannot be added without a knowledge of the strength of the wine, and as, moreover, this correction is influenced by the amount of extractive, the specific gravity should always be taken at 15·5° C. The wine should also previously be shaken to expel carbonic acid. The specific gravity of the evaporated and re-diluted wine is next ascertained with the same precaution, and the data thus obtained, when treated according to the second of the above formulæ, give the specific gravity sought. To show the degree of accuracy afforded by this method we give the following determinations, in which the alcohol was estimated both by the method here described and by distillation. These analyses are taken at random out of upwards of one hundred comparative determinations.

If sufficient care be taken the estimations will rarely differ more than 0·25 per cent., and not unfrequently the results of both processes will be almost identical.

Nos.	D.	D¹.	X.	Corresponding strength.	Strength by distillation.	Error.
1	990·57	1007·59	982·98	10·83	11·21	− 0·38
2	991·67	1006·80	984·87	9·29	9·53	− 0·24
3	991·60	1010·39	981·21	12·23	12·35	− 0·12
4	985·98	1009·98	976·00	16·42	16·39	+ 0·18
5	997·32	1009·55	987·77	7·26	7·44	− 0·18
6	995·98	1020·46	975·52	16·82	16·80	+ 0·02

The accuracy obtainable by this process is therefore sufficiently great for practical purposes, whilst, as regards rapidity and facility of execution, no other proceeding is at all comparable to it, more particularly when large numbers of samples have to be examined. In such a case it is only necessary to set all, or as many as possible, of the samples evaporating on the steam-bath. Whilst the evaporation is proceeding the specific gravity of all the wines is taken, and by the time this is accomplished the evaporation will have been finished, the residues have become cool, and be ready for filling up and the determination of their specific gravity. In effect, therefore, one estimation takes up no more time than is consumed in the determination of two specific gravities, and in twice measuring 100 c.c., or weighing out 100 grammes. As, however, in the ordinary practice of analysis as applied to wines, the specific gravity is always taken, quite independently of the particular method employed for the determination of the alcohol, a practice which is a great safeguard of correctness, it is quite fair to subtract the time employed in the ascertaining of the specific gravity of the wine from the time occupied by the entire process. Further, as the second specific gravity D′ gives us the means of calculating the solid residue contained in the wine with considerable accuracy and approximation to the truth, even the time spent over this determination is not wholly employed in the estimation of alcohol. If only a single sample has to be analysed, considerable time will certainly be required on account of the evaporation, which, being necessarily slow, may consume about an hour; in return for this delay, however, the operation requires no attention, and the operator is at perfect liberty to attend to other matters. Now, great rapidity in the estimation of alcohol is of value only if nothing but the alcohol has to be determined. If anything besides the amount of alcohol is required to be known, the analysis of necessity occupies much time, and a process which requires little actual work or attention, even if it occupies much time, is of greater value than a process which may be finished in fifteen minutes, but requires complete attention during the whole of that time. Under all circumstances, the plan here considered has the advantage over every other, when six samples and upwards have to be examined contemporaneously.

It is assumed in this process that the substances present in solution are not altered in their nature during evaporation, and that no volatile substances are present besides the alcohol; further, it has been assumed that the specific volume of substances present in the solution is the same in diluted spirit as in water, an assumption which may be to a slight degree incorrect. Indeed not one perhaps of the foregoing assumptions is strictly and absolutely true as regards wine, but, as the result of our numerous experiments, it may be stated that they are sufficiently near truth to enable us to obtain results accurate enough for the practical purposes of science, trade, or common life.

METHODS OF ALCOHOL DETERMINATION BASED UPON THE BOILING-POINT OF ALCOHOLIC MIXTURES.

Many learned men have proposed and used the boiling-point of alcoholic liquids as a measure of their strength. A number of instruments, to most of which the name of *ebullioscope* has been given, have been devised for this purpose by Brossard, Vidal, Pohl, Ure, Conaty, and others. These instruments, being all based upon the same principle, could of course differ in matters of detail only. Their general construction is mostly as follows. Upon a stand is fixed a small metal boiler to receive the wine, heated by a small spirit-lamp underneath the boiler. A delicate thermometer is sunk into the boiler to determine the boiling-point. This thermometer is, however, mostly provided with a converted scale, that is to say, an indicator

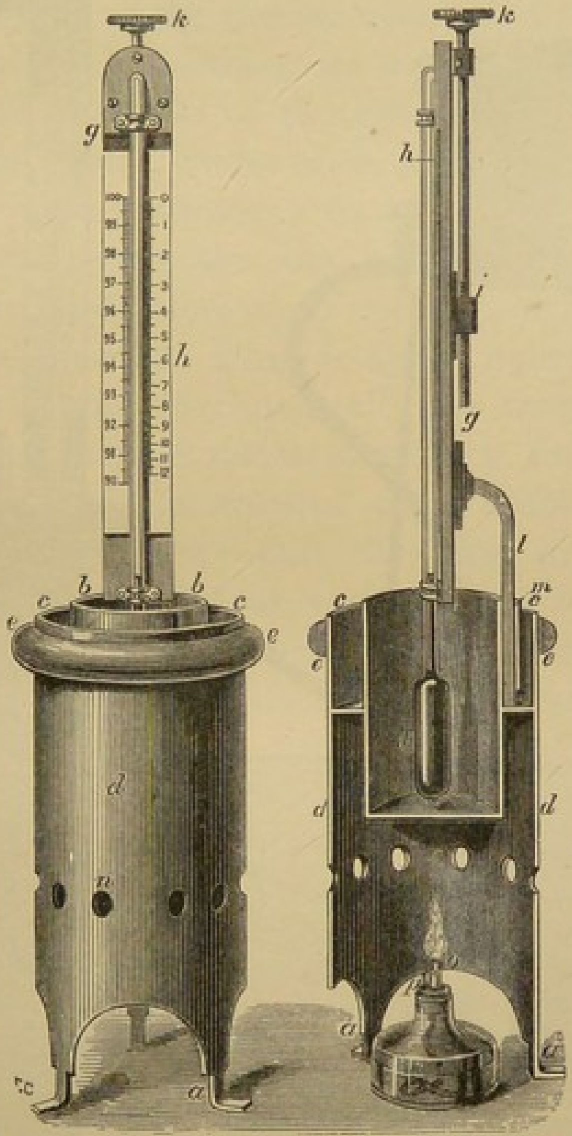


FIG. 28.—Elevation and section of Pohl's Ebullioscope (one-fourth of natural size). The thermometer has a movable scale, which, by means of the screw *k*, can be adjusted to the boiling-point of water. The scale shows degrees centigrade on the left and per cent. alcohol by weight on the right.

which shows at once the percentage of alcohol in the boiling fluid, and not the temperature of its vapour. In some of the instruments a small condenser is added to fix the vapours and compel the fluid to run back into the boiler, and thus keep the alcoholic strength of the boiling liquid constant. The scale of the thermometer is movable, so that the zero-point can at any time be adjusted to the boiling-point of water. The estimation of the alcoholic strength of a wine by means of such an instrument, although in theory exceedingly simple,

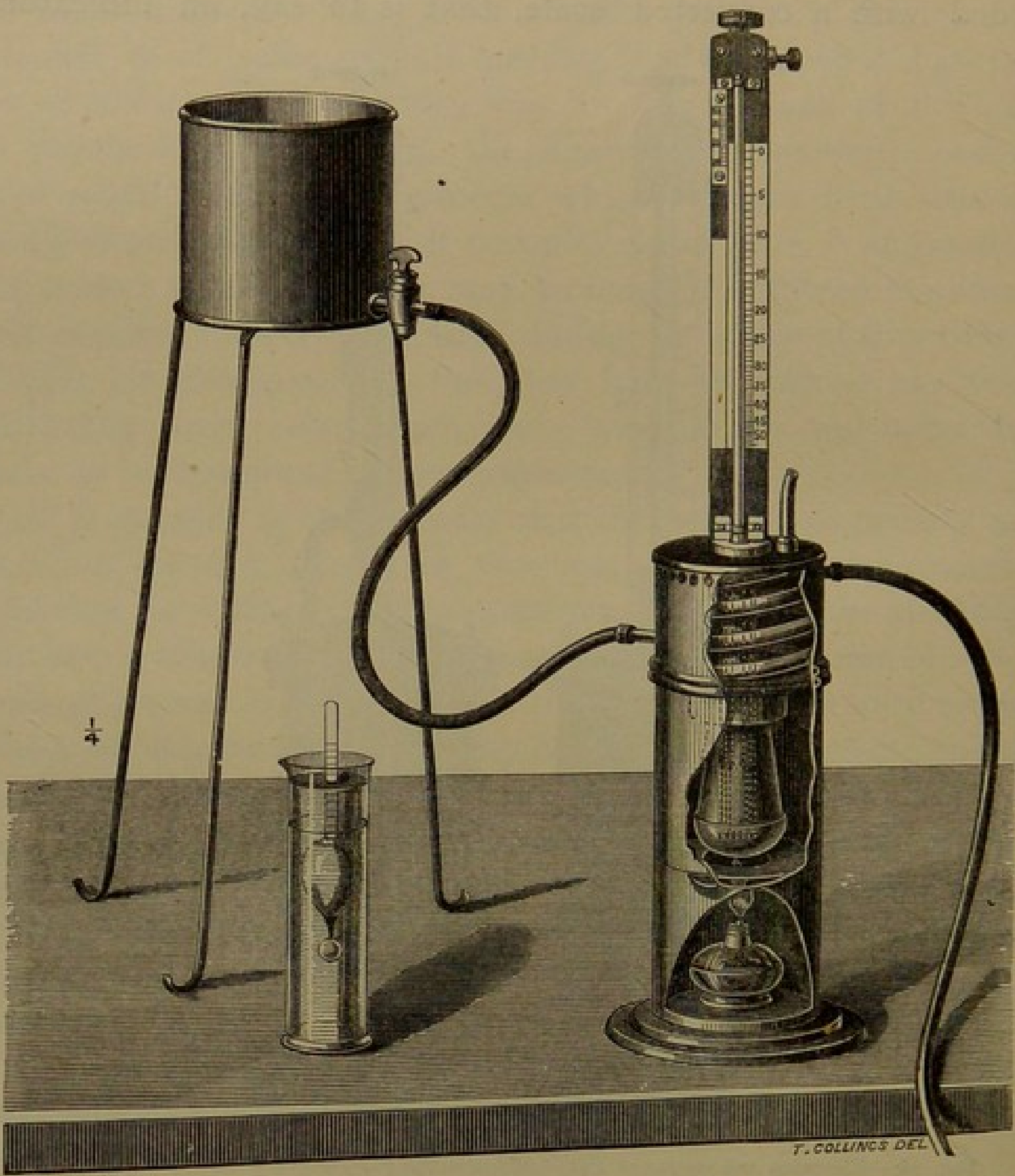


FIG. 29.—Crockford's Patent Spirit Indicator, with hydrometert or taking the spec. gr. of the wine. A small condenser is fixed on the top of the boiler to prevent the loss of alcohol during boiling. The zero of the scale of the thermometer can be adjusted to the boiling-point of water by means of the top screw, and can then be fixed at the desired point by the clamping screw at the side. The scale shows directly degrees of Sykes.

is by no means so easy in practice. The experiment is conducted as follows.

If the instrument has a thermometer with movable scale, a certain measure of water is placed in the boiler, the thermometer is introduced, and the lamp lighted; when the water boils and the position of the mercury in the thermometer has become constant, the zero of the scale is adjusted accordingly. Now this is by no means an easy operation, as everybody will admit who has attempted to ascertain the boiling-point of water with the bulb of the thermometer dipping into the boiling liquid; and all the instruments we have examined are so constructed that the bulb of the thermometer dips into the boiling water or wine. Under these circumstances an error of from $0^{\circ}\cdot5$ to 1° in the endeavour to adjust the zero may very easily be made. After the zero-point has been fixed the boiler is emptied and allowed to cool; a measure of wine is then introduced, and the lamp is again lighted. A curious phenomenon will now develop itself; the thermometer rises, at first steadily, then becomes stationary for a time, then rises again, and again is arrested for a moment at a given point. This clearly shows that the wine around the bulb becomes weaker in alcohol at various periods, and causes the mercury to rise. It is therefore necessary to fix upon one of the stationary points as the true boiling-point of the wine if an open boiler be used. Pohl takes the second stop when the thermometer will remain stationary for about fifteen or eighteen seconds; that is to say, in instruments of the exact construction and dimensions adopted by Pohl. This point depends, however, not only upon the alcoholic strength of the boiling wine, but to a great extent upon the size of the flame which burns underneath the boiler; and it is therefore necessary, though not easy, to use always a flame of the same size and spirit of the same strength. Besides, if the flame and instrument be not very carefully guarded against the slightest draught, the thermometer may remain stationary for a time on account of the flame being affected by the draught; a little careless breathing near the instrument is sufficient to produce this result, and occasion a very considerable error. Those instruments which are provided with a condenser are only a little less inaccurate, and, unless the condenser be very large, the thermometer rises continually at intervals. The condensed liquid runs back into the boiler as often as its quantity is sufficient to overcome adhesion, and causes the thermometer to fluctuate. Altogether, through the difficulty of adjusting the zero and fixing the boiling-point, an error of 1 per cent. or even 2 per cent. in the alcohol is frequently committed. Indeed, some of the chief advocates of this instrument differ greatly in their statements concerning the boiling-point of alcoholic liquids of the same strength. According to Pohl, the boiling-point of a wine which does not contain too great an amount of extractive is a function only of its alcoholic strength, and practically uninfluenced by the extractive; he instances as an example that a mixture of 10 parts of alcohol and 90 parts of water boils at the same temperature as a mixture of 10 alcohol, 15 sugar, and 75 water. In his little book on Austrian wines, however, he gives a number of experiments performed by several French chemists which are entirely opposed to this opinion, inasmuch as they show that the boiling-point of such mixtures is not a function of their alcoholic strength, but rather a function of the proportion existing between the alcohol and water, irrespective of the other constituents. For example, a spirit showed 20·05 per cent. b. v., as tested by the ebullioscope; in this enough sugar was dissolved to bring its specific gravity to 1 (about 5·95 per cent. of sugar, according to our calculation); the ebullioscope still showed 20·05 per cent., while the percentage of alcohol in the entire mixture was in reality only 19·268 per cent. Another spirit showed 8·05 per cent. with this instrument: in 200 c. c. of it 28 grammes of tartaric acid were dissolved; whereupon this mixture still showed 8·05 per cent. alcohol, the boiling-point in each case being 92°. In the second mixture, however, only 7·04 per cent. of alcohol were in reality present. In the same little work several other experiments of a similar nature are mentioned, which, as regards the effect of sugar, we are able fully to confirm. A spirit of 10 per cent. b.w. boils sensibly at the same temperature, even after 10 or 20 per cent. of sugar has been dissolved in it, though in the last case the percentage of alcohol is only 8·3 instead of 10. With some of the instruments sold in London a compensation table is supplied. The varying character of the extractive matters render, however, an accurate compensation capable of fitting all wines a matter of impossibility. The very fact, moreover, that one of the principal advocates of the use of the ebullioscope could fall into such an error as to suppose that the boiling-point was a function of the alcoholic strength only, sufficiently demonstrates the difficulty of accurately fixing the boiling-point of a mixture like wine at all. It is impossible accurately to fix the boiling-point of any fluid, if, as is the case with all the ebullioscopes which we have obtained or seen described, the bulb of the thermometer dips into the boiling liquid. In those instruments where the scale of the thermometer is moveable, and the zero has to be adjusted to the boiling-point of water at each occasion of use, the error committed by the immersion of the bulb is still greater; it would be better to have the scale fixed, and apply the correction for varying barometric pressure by means of a table.

METHOD OF ALCOHOL-DETERMINATION BASED UPON THE VAPOUR TENSION OF ALCOHOLIC LIQUIDS.

GEISLER'S INSTRUMENT—VAPORIMETER.

The vaporimeter has been invented and constructed by the philosophical mechanician Geisler, of Bonn, and its theory was afterwards made the subject of research by Professor Plücker. It is based upon the circumstance that the tension of the vapour of a mixture of pure alcohol and water at the temperature of 100° rises with the alcoholic strength. The tension of a vapour rising from a mixed liquid is, however, greatly influenced by the relative space occupied by the vapour and the unevaporated part of the mixture, and this particular circumstance so far modifies the general applicability of the above law, that in practice it becomes requisite either to manufacture the different parts of all instruments of the same relative sizes, or to graduate each instrument separately.

The instrument made by M. Geisler consists of a small brass boiler A, in which water can be boiled; a small flask O, fitted by means of a stopper to the double bent pressure

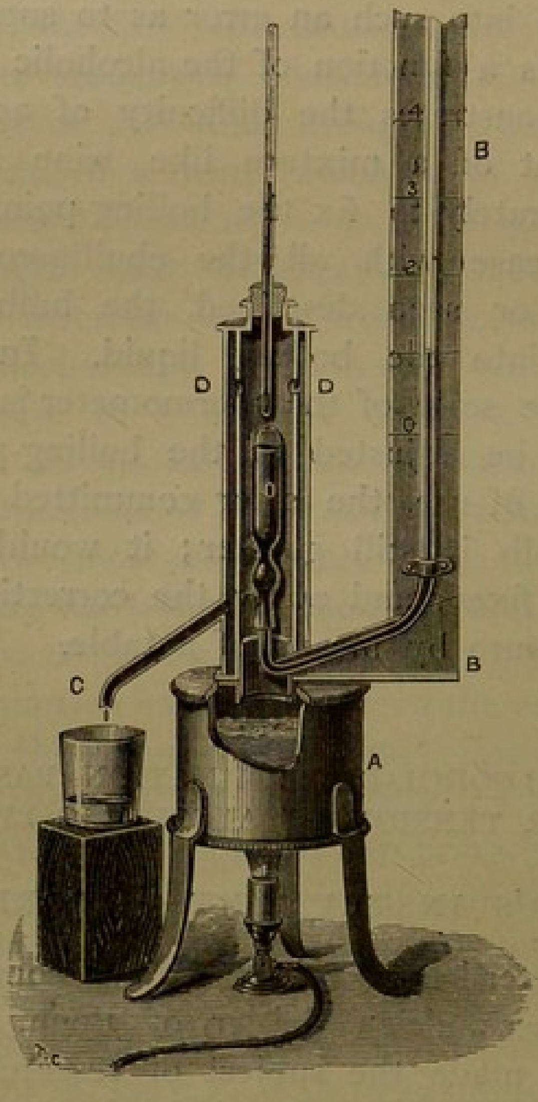


FIG. 30.—Geisler's Vaporimeter (about one-fifth of natural size). The rising tube and scale B B is represented up to one-third of its relative length only.

tube B; it can be fixed together with the double steam-jacket and thermometer on the boiler A. The steam from the boiling water rises up the cylindrical central space, heating thereby the flask O, then goes through the apertures D D, into the outer jacket, and escapes at C. By these means the little flask O is heated to a constant temperature, measured by the thermometer fixed in the top of the steam-chamber.

To fill the instrument for use the steam-jacket is lifted off, the bottle and pressure tube are detached from the boiler and inverted; the little flask is next separated from the tube, and having been previously filled up to the contracted neck with clean mercury is entirely filled with the wine to be tested. The bottle is now again fixed to the tube and inverted; the wine will now of course occupy the top of the bottle, where no air-bubbles should be visible. The bottle and tube are fixed over the boiler, the steam-jacket is replaced, and the water boiled. As the wine in the flask becomes heated, vapour will be formed, and some of the mercury be forced from the bottle into the tube, in which it will gradually rise until the height of its column exactly counteracts the pressure of the vapours rising from the wine at the temperature of boiling water, as marked by the thermometer. This height to which the mercurial column rises is the measure of the alcoholic strength of the wine.

The instruments are provided with converted scales, which give at once the per cent. of alcohol by weight or volume. But as water boils at different temperatures at different times or places, a table is provided giving the amount of correction for temperature to be applied to the strength found.

This instrument, at first sight so ingenious and apparently accurate, offers in practice some very considerable difficulties. Firstly, the carbonic acid present in all wines requires to be removed by the addition of a little dry slaked lime and filtration. Secondly, wine, even after this treatment, holds more or less air in solution, which being expelled by the heating, augments the pressure so as to increase the apparent percentage of alcohol by from 0·2 to 0·4 per cent. above the real. As a consequence of this circumstance, it is always discovered that after heating and partial cooling an air-bubble has collected at the top of the wine. By carefully inverting the flask and pressure-tube this bubble can be removed, and on second heating a lower percentage of alcohol will be found. This removal of the air requires so much time and trouble, that the estimation has virtually to be made twice over. This trouble is accompanied with much danger to the instrument, which has to be handled while it is yet quite hot, as otherwise the air or gas would again, at least partially, dissolve in the cold wine. Nevertheless a second, or after its removal even a third air-bubble will sometimes make its appearance on re-heating. Nor is it exactly an unmixed advantage if all the air has been got rid of, for then the attraction between the glass and wine is so great that sometimes no vapour at all is produced on heating, and the mercury in the tube does not rise even if the water be kept boiling for several minutes. If then the instrument be slightly shaken, a sudden burst of vapour is evolved, which not unfrequently throws out some mercury, or loosens the connections between bottle and pressure-tube, and thus spoils the experiment. In rare instances, no amount of shaking that can be safely applied to the instrument is sufficient to induce the formation of vapours.

The vaporimeter, like the ebullioscope, does not indicate the strength of the wine, but only the proportion between water and alcohol, without regard to all such solid constituents as have no chemical affinity for the water or alcohol. For example, three portions of spirit of 14·8 per cent. were taken: one portion tested gave, with the aid of the necessary corrections, 14·8 per cent.; in the second portion 10 per cent. sugar was dissolved, the instrument gave its strength as 14·7 per cent.; in the third portion 20 per cent. of sugar was dissolved; the instrument still gave the strength as 14·9 per cent., although in reality the last sample contained only 10·93 per cent. of alcohol. The error thus committed is not very considerable in light wines containing little solid matter, but with strong heavy wines it may rise to a considerable amount.

If the substances present in the wine have any affinity for water, this error is greatly augmented; in one ounce of the above spirit (14·8 per cent.) 100 grains of calcium chloride were dissolved, after which the instrument gave the strength of the mixture as 21·81 per cent., whilst in reality it was only 12·27 per cent.

Any substances present in the wine which are more volatile than alcohol may also influence the result considerably. In several samples of Greek wines, and in a sample of Sauterne, we have met with aldehyde. The latter wine when treated by distillation gave 9·22 per cent. of alcohol, whilst the vaporimeter gave its strength as 10·45 per cent.

The chief advantages of the instrument are that but a very small quantity of wine is required, and that constant watching is not necessary, as the mercury does not continue to rise, but remains stationary at a given point. On the other hand, one single estimation, with rendering the wine alkaline, filtering and heating it, removing the air-bubble and again heating it, occupies at least half an hour, and is therefore decidedly slower than the process by means of the ebullioscope. But the vaporimeter is superior to the ebullioscope in accuracy thus far, that the error that can be made is less considerable than that to which the ebullioscope is liable.

As the instrument is provided with a converted scale, showing percentages at once, we must either remain entirely dependent on the accuracy of the maker or control it by a number of careful experiments; and if unhappily the small bottle or pressure-tube is broken, the graduation has to be effected anew. It is very necessary to verify every instrument, as the following experiments will show.

Four samples of diluted spirit were prepared, and their strength carefully estimated by specific gravity (portions of the same samples were used in the experiments on distillation). They were then carefully examined by our Geisler's instrument, the necessary corrections for temperature being of course added.

		Difference.
1. Strength by specific gravity	16·87	1·63
,, vaporimeter	15·24	
2. Strength by specific gravity	13·76	0·77
,, vaporimeter	12·99	
3. Strength by specific gravity	10·03	0·50
,, vaporimeter	9·53	
4. Strength by specific gravity	4·81	0·39
,, vaporimeter	4·42	
5. Strength by specific gravity	2·30	0·36
,, vaporimeter	1·94	

We extract a similar table from Mohr, *loc. cit.*

			Difference.
1. Strength by specific gravity	... ...	20·	1·2
,, vaporimeter	... ...	18·8	
2. Strength by specific gravity	... ...	15·	1·6
,, vaporimeter	.. ...	13·4	
3. Strength by specific gravity	... ...	10·	1·2
,, vaporimeter	... ...	8·8	
4. Strength by specific gravity	... ...	5·	0·8
,, vaporimeter	... ...	4·2	

From these results it appears that the determination of alcohol by Geisler's instrument generally furnishes quantities which are below those actually contained in the mixtures.

We subjoin a number of comparative estimations of alcohol in various wines, premising that in all of them the previously estimated error of the instrument has been added.

Light Claret.	By distillation	9·05
	By vaporimeter . . .	10·1
	Dry residue left by wine . .	2·167 per cent.
Hungarian Wine.	By distillation . . .	10·59
	By vaporimeter . . .	9·89
	Dry residue . . .	1·873 per cent.
Steinberg Cabinet.	By distillation . . .	9·74
	By vaporimeter . . .	9·26
	Dry residue . . .	1·478 per cent.
Rauenthaler.	By distillation . . .	7·44
	By vaporimeter . . .	7·77
	Dry residue . . .	1·8 per cent.
Marsala.	By distillation . . .	16·92
	By vaporimeter . . .	17·84
	Dry residue	3·3 per cent.
Hattenheimer.	By distillation . . .	9·97
	By vaporimeter . . .	9·75
	Dry residue	1·4 per cent.
Marsala.	By distillation . . .	16·80
	By vaporimeter . . .	17·79
	Dry residue	3·5 per cent.

METHOD OF ALCOHOL-DETERMINATION BASED UPON THE EXPANSIBILITY OF ALCOHOLIC MIXTURES BY HEAT.

SILBERMANN'S DILATOMETER.

Pure absolute alcohol, when heated from 0° to 78·3° C., expands from 1 to 1·0936, whilst water between the same limits expands only from 1 to 1·0278. The expansion of alcohol is therefore nearly 3½ times greater than that of water.

This is the absolute expansion, but the difference between the apparent expansion of the two as measured in a glass vessel is even a little greater. If we could measure the expansion in a vessel having the same co-efficient of expansion as water, it is obvious that in such a vessel water would show no expansion whatever, whilst the apparent expansion of alcohol would still be $2\frac{1}{3}$ times greater than the absolute expansion of water. In mixtures of alcohol and water, the rate of expansion increases with the increasing percentage of alcohol, though in rather a greater ratio, and is consequently a function of the strength.

Upon these considerations Silbermann has based the construction of his instrument, termed the dilatometer. It may be considered as a large thermometer which is always filled to the same point with the wine to be tested, and the amount of expansion when the wine is heated from 25° C. to 50° C. is measured by the rise of the liquid in the stem, which latter is provided with a converted scale showing at once percentages.

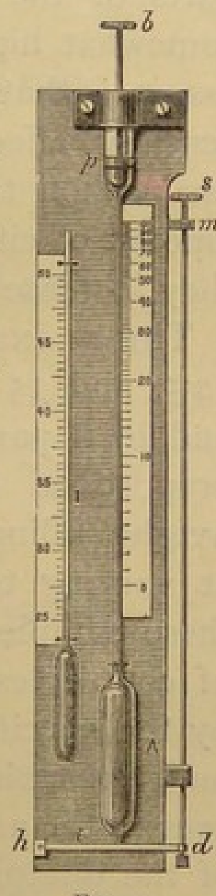


FIG. 31. Silbermann's Dilatometer.

To facilitate the filling of the instrument, it is made like a pipette, the lower opening of which can be closed by a cork-disk, pressed against it by a long screw worked from the top. Into the upper narrow end an air-tight piston with hollow rod is fitted, which can be used as a small air-pump, by means of which the air can be removed from the wine previous to heating.

The instrument being filled to a point somewhat above the mark, and the air removed, is next placed into a water-bath heated to 25° C., the temperature being measured by a mercurial thermometer fixed to the same plate as the dilatometer. Here the first serious difficulty is encountered, for except when the bath has been kept stationary at a temperature of 25° C. for at least ten minutes, we cannot be sure that the wine in the instrument has the same temperature as that shown by the mercurial thermometer. The temperature having been obtained, and retained sufficiently long, which is by no means easy, the excess of wine is allowed to run out by slightly opening the lower aperture, so that the instrument remains filled just to the proper mark. The temperature of the water-bath is next raised to 50° C., when the same difficulty as at the lower temperature will be encountered in a higher degree. When at last the temperature has been kept up sufficiently long, the rise of the wine in the stem of the instrument gives the strength. As the instruments sold in trade are provided with a converted scale, each instrument has to be verified. The graduation appears generally to give equal intervals for one per cent. in different parts of the scale, although the expansion increases in a somewhat higher proportion than the strength. Silbermann assumes that the presence of sugar or extractive does not sensibly affect the rate of expansion. We believe this assumption to be correct only in those cases where a small amount of either is present; when a larger amount is present, they increase the expansion.

Three examples of spirit, containing respectively 10, 12·5, and 15 per cent. by weight, were carefully prepared, and in a part of each of the first and last sample varying proportions of sugar were dissolved. The quantity by weight filling a specific gravity bottle (Fig. 26, p. 134) at varying temperatures was then determined for each of these samples. At higher temperatures the bottle holds of course less liquid by weight, and this loss when divided by the specific gravity of the liquid gives the increase in bulk in cubic centimetres. This bulk in centimetres expresses the amount by which the liquid would rise in the stem of the dilatometer; but as the temperature of the liquid is determined by a thermometer immersed in it, and as with the balance variations in weight of 0·1 to 0·2 milligrammes are perceptible, much more accurate results are obtained by weighing than by the observation of dilatation.

The specific gravity bottle was cooled or heated in a large water-bath, the water of which was kept in a constant state of agitation. A thermometer was at the same time placed into the water of the bath, and the heat so regulated that this thermometer and the thermometer in the specific gravity bottle showed as nearly as possible the same temperature. The bottle on being taken out of the bath was dried and allowed to stand in the balance case until it had assumed the proper temperature.

Spirit of 10 *per cent. Specific gravity*, 983·8.

Weight of contents of bottle at	10°	=	23·1142 grms.
,, ,, ,,	25°	=	23·0356 ,,
,, ,, ,,	50°	=	22·7954 ,,
Loss in weight between	10° and 25°	=	0·0766 ,,
,, ,, ,,	25° and 50°	=	0·2402 ,,
Increase in bulk between	10° and 25°	=	0·0776 cub. cent.
,, ,, ,,	25° and 50°	=	0·2441 ,,

Spirit of 12·5 *per cent. Specific gravity*, 980·8.

Weight of contents of bottle at	25°	=	22·9503 grms.
,, ,, ,,	50°	=	22·6979 ,,
Loss in weight between	25° and 50°	=	0·2524 ,,
Increase in bulk between	,, ,,	=	0·2573 cub. cent.

Spirit of 15 *per cent. Specific gravity*, 977·7.

Weight of contents of bottle at	10°	=	22·9708 grms.
,, ,, ,,	25°	=	22·8701 ,,
,, ,, ,,	50°	=	22·5986 ,,
Loss in weight between	10° and 25°	=	0·1007 ,,
,, ,, ,,	25° and 50°	=	0·2715 ,,
Increase in bulk between	10° and 25°	=	0·1029 cub. cent.
,, ,, ,,	25° and 50°	=	0·2766 ,,

Summary.—Increase in bulk between 25° and 50°:—

Of 10 per cent. spirit	0·2441 cub. cent.
,, 12·5 ,, ,, ...	0·2573 ,,
,, 15 ,, ,, ...	0·2766 ,,

Mean rise of increase per cent. between

10 per cent. and 12·5 per cent.	= 0·0053 cub. cent.
12·5 ,, and 15 ,,	= 0·0077 ,,

Increase in bulk between 10° and 25°:—

Of 10 per cent. spirit	= 0·0778 cub. cent.
,, 15 ,, ,,	= 0·1029 ,,

Mean increase in bulk for a rise of one degree between the temperatures of 10° and 25°:—Spirit of 10 per cent. 0·0052; spirit of 15 per cent. 0·0068.

Between the temperatures of 25° and 50°:—

Spirit of	10	per cent.	0·00976 cub. cent.
,,	12·5	,,	0·01029 ,,
,,	15	,,	0·01106 ,,

Spirit and Sugar. *Spirit of* 10 *per cent. with* 5 *per cent. cane-sugar dissolved in it. Specific gravity*, 1003·8.

Weight of contents of bottle at	10°	=	23·5832 grms.
,, ,, ,,	25°	=	23·9958 ,,
,, ,, ,,	50°	=	23·2529 ,,
Loss in weight between	10° and 25°	=	0·0867 ,,
,, ,, ,,	25° and 50°	=	0·2429 ,,
Increase in bulk between	10° and 25°	=	0·0864 cub. cent.
,, ,, ,,	25° and 50°	=	0·2419 ,,

Spirit of 10 *per cent. with* 10 *per cent. of sugar dissolved in it. Specific gravity*, 1023·8.

Weight of contents of bottle at	25°	=	23·9571 grms.
,, ,, ,,	50°	=	23·7110 ,,
Loss in weight between	25° and 50°	=	0·2461 ,,
Increase in bulk between	25° and 50°	=	0·2403 cub. cent.

Spirit of 15 *per cent. with* 10 *per cent. of sugar. Specific gravity*, 1017·7.

Weight of contents of bottle at	10°	=	23·9144 grms.
,, ,, ,,	25°	=	23·7990 ,,
,, ,, ,,	50°	=	23·5212 ,,
Loss in weight between	10° and 25°	=	0·1154 ,,
,, ,, ,,	25° and 50°	=	0·2778 ,,
Increase in bulk between	10° and 25°	=	0·1133 cub. cent.
,, ,, ,,	25° and 50°	=	0·2730 ,,

Summary.—Increase in bulk between 25° and 50°:—

Of	10	per cent. spirit with	5	per cent. sugar	0·2429 cub. cent.
,,	10	,, ,,	10	,, ,,	0·2403 ,,
,,	15	,, ,,	10	,, ,,	0·2730 ,,

Increase in bulk between 10° and 25°:—

Of	10	per cent. spirit with	5	per cent. sugar	0·0864 cub. cent.
,,	15	,, ,,	10	,, ,,	0·1133 ,,

Mean increase in bulk between temperatures of 10° and 25° for a rise of one degree:—

Of	10	per cent. spirit with	5	per cent. sugar	0·0057 cub. cent.
,,	15	,, ,,	10	,, ,,	0·0075 ,,

Mean increase for a rise of one degree between 25° and 50°:—

Of	10	per cent. spirit with	5	per cent. sugar	0·00967 cub. cent.
,,	10	,, ,,	10	,, ,,	0·00961 ,,
,,	15	,, ,,	10	,, ,,	0·01092 ,,

Increase in bulk between 10° and 25°:—

Of	10	per cent. spirit	= 0·0778 cub. cent.
,,	10	,, ,, with 5 per cent. sugar	0·0864 ,,
,,	15	,, ,,	= 0·1029 ,,
,,	15	,, ,, with 10 per cent. sugar	0·1154 ,,

Increase in bulk between temperatures of 25° and 50°:—

Of 10 per cent. spirit			=	0·2441 cub. cent.	
,, 10	,,	,, with 5 per cent. sugar		0·2419	,,
,, 10	,,	,, ,, 10 ,,	=	0·2403	,,
,, 12·5	,,	,,	=	0·2573	,,
,, 15	,,	,,	=	0·2766	,,
,, 15	,,	,, with 10 per cent. sugar		0·2730	,,

According to this the strength of the

10 per cent. spirit with 5 per cent. sugar would be found 9·58 per cent. instead of 9·5 per cent.

10 per cent. spirit with 10 per cent. sugar would be found 9·27 per cent. instead of 9·0 per cent.

15 per cent. spirit with 10 per cent. sugar would be found 14·54 per cent. instead of 13·5 per cent.

These detailed calculations and observations show that the addition of sugar to spirit increases the rate of expansion very decidedly at lower temperatures; but inasmuch as the rate of increase in the expansion is less rapid in the spirit with sugar than in the spirit alone, the latter gradually overcomes the other, so that at higher temperatures the amount of expansion of the pure spirit is higher than that of the spirit and sugar. It may thus be possible to select a range of temperature in which the increase in bulk of these two spirits is exactly proportional to their strength. This is very nearly the case between the temperature of 25° to 50°, provided the wine is not too strong and does not contain more than about 5 per cent. of extractive.

With wines which fulfil this proviso Silbermann's instrument may give tolerably accurate results, provided very great care is exercised in the filling of the instrument and in the management of the temperature. But of all the different instruments proposed this will certainly require the greatest amount of care. To strong wines containing much solid matter the instrument, as usually constructed, is quite inapplicable.

RÉSUMÉ.

With light wines all the methods considered give tolerably accurate results; the process of distillation and Balling's plan give, however, the best results. The other methods require great care and skill, and are liable to very considerable errors from even slight inattention to minute points in the manipulation or in the character of the wine. With strong heavy wines no process except that of distillation and Balling's plan deserves any consideration, the latter plan being also in all cases the most expeditious where a number of alcohol determinations have to be performed.[1]

EXPERIMENTS ON THE STATE IN WHICH ALCOHOL IS CONTAINED IN WINE.

The question whether alcohol is present in wine as free alcohol or is only produced and liberated during distillation, has frequently been asked, and answered sometimes in the negative, sometimes in the affirmative. The observation giving rise to this question is that pure wine differs in taste from wine to which alcohol has been added. Most persons of moderate experience in tasting wine are able to detect the addition of a few per cent. of alcohol to a wine, even if its strength after this addition is not greater than the strength of many pure wines in which the spirit cannot be detected by the taste. A practised wine taster will detect the addition of even a few pro milles of alcohol to a pure wine. From this fact it has been argued that, inasmuch as no alcohol can be tasted in the pure wine, whilst the addition of even a few pro milles is instantiy detected, no free alcohol is contained in the wine, but that it exists in some kind of combination, and that the application of heat breaks up the compound, alcohol distilling over, the other constituent remaining behind. This notion being once started, it was soon endeavoured to prove its correctness by other means than the palate. It was alleged that the alcohol naturally present in the wine required a greater amount of heat to distil off, and could not be separated by the addition of an excess of anhydrous potassic carbonate; whilst the alcohol added could be more readily distilled off and could be easily separated by the addition

[1] It has also been proposed to estimate the alcoholic strength of a wine by its capillary attraction. Irrespective, however, of the serious difficulty of accurately estimating this capillarity, we find that the presence of sugar has such a strong influence on its amount as to make this method totally inapplicable to the purpose proposed.

of potassic carbonate. These statements were, however, proved to be erroneous soon after their first publication; nevertheless the idea of the production of the alcohol during distillation is still maintained by some, and has a strong hold upon many of the public, the evidence believed to be afforded by the palate being by them thought unanswerable. We have therefore taken some trouble to investigate this point, and may at once state that we have not found a single physical or chemical property possessed by wine, which is not in perfect harmony with the assumption that it contains the alcohol as a simple admixture, and not in any sort of combination.

The experiments undertaken with a view of deciding this point were the following. A pure wine was taken from which the spirit was carefully distilled off in a water-bath, with the precautions previously described to avoid loss of spirit; the distillate was then again added to the residue in the retort. In this manner a mixture was obtained as nearly as possible the same as the original wine, but containing all its alcohol as distilled, free alcohol. This mixture was then compared with the original wine. No difference between the two could be detected as regards (1) the specific gravity, (2) boiling-point, (3) vapour tension at low and high temperatures, (4) effects of freezing, (5) facility with which the alcohol could be separated, (6) endosmotic equivalent, (7) capillary attraction, and (8) specific heat. Points 1, 2, and 3 were estimated in the usual manner. To test point 5, equal quantities of wine or mixture were placed in a retort, itself immersed in a water-bath heated to various degrees of temperature, whilst a rapid current of air was driven through the liquid in the retort. After a certain quantity of air had been blown through, the alcoholic strength of the residue was determined. It was found that up to a temperature of about 40° C. the wine or mixture evaporated nearly as a whole, the strength of the residue scarcely diminishing, at the same time no difference whatever being perceptible between the original wine and the mixture. The endosmotic equivalent was estimated as follows:—A short wide tube was taken, the lower end of which was closed by having a piece of thin pig's bladder stretched over it. Into this tube a certain quantity of wine was weighed, and it was then suspended in a large beaker of distilled water, so that the inner and outer levels were equal. The water in the beaker was changed daily, and the weight of tube and contents taken. The experiment was considered closed when two weighings of the tube separated by an interval of a day were identical. The contents of the tube were then thrown away, and a quantity of distilled, &c. wine placed in instead, and treated otherwise exactly as above. The weight of the tube had become constant in forty-five days in the first, and in thirty-three days in the second case; the temperature in the first case being throughout lower than in the second. It was then found that for every one part of alcohol that had passed outward through the bladder into the water in the case of the wine, 6·35 parts of distilled water had passed into the tube; in the case of the distilled, &c. wine, 6·42 parts had passed in. The endosmotic equivalent is therefore the same for both, for these two figures are quite as close as two successive experiments with the same wine would have been.

The capillary attraction was measured in two tubes. At a temperature of 8° C. the wine rose to 52·78 and 35·73^{mm} respectively; the distilled, &c. wine to 52·85 and 35·78^{mm}. Lastly, the specific heat of the wine and distilled, &c. wine were compared: the former was found to be 1·0047, the latter 1·0054, yielding a difference quite within the limits of error of the experiment.

It will thus be seen that in all the foregoing eight characters, some of which, such as the endosmotic equivalent and the specific heat, would certainly have revealed even slight differences in the physical or chemical character of the two liquids had there been any, no difference could be detected; and we are therefore justified in assuming that no such difference exists. The indubitable difference in taste between the alcohol naturally present and the alcohol added, must therefore be otherwise accounted for. The alcohol from fermented liquids is always accompanied by other substances;

some of them, like the alcohol, products of fermentation; others produced by the action of the heat on parts of the fermented liquid. Some of these products adhere to the alcohol with the greatest pertinacity, so as to be scarcely separable, and impart to it in great measure the pungent taste. What tastes disagreeable, therefore, is not the alcohol, but these foreign admixtures. That this is probably the correct explanation is shown by the fact that the greater the trouble taken in purifying alcohol, the less marked is this taste. If, for example, what is ordinarily called pure spirit of wine is distilled repeatedly over caustic lime, is then diluted to a strength of 20 to 30 per cent. and filtered frequently through fresh charcoal, the taste becomes less and less pungent, and, if judged by the taste, the mixture would be taken as very much weaker than in reality it is. It seems therefore reasonable to suppose that, if we should succeed in obtaining alcohol absolutely free from these admixtures, it would be found as free from this peculiar (spirituous) taste as wine itself.

ALDEHYDES IN WINE.

An aldehyde is the first product of the conversion of a primary alcohol into its acid, by means of an oxydizing agent, thus:—

$$\underset{\text{Alcohol.}}{C_n H_{2n+2} O} + O = \underset{\text{Aldehyde.}}{C_n H_{2n} O} + H_2 O.$$

$$\underset{\text{Aldehyde.}}{C_n H_{2n} O} + O = \underset{\text{Acid.}}{C_n H_{2n} O_2}.$$

The only aldehyde of the series which has been proved to be present in wine, up to this time, is acet-aldehyde ($C_2 H_4 O$), produced by the oxydation of ethylic alcohol. It seems not improbable, however, that wine owes part of its bouquet to the presence of some of the higher members of the series. Their presence may perhaps be inferred from the considerable absorbing power for oxygen possessed by some wines, a property highly characteristic of aldehydes.

ACET-ALDEHYDE.

Wine, when exposed to the action of atmospheric air, is gradually converted into vinegar. If a tolerably free access of air be permitted, the only product formed from the alcohol is acetic acid. If, however, the access of air is very limited, oxydation frequently stops short at the first stage, and aldehyde is formed. This conversion of alcohol into aldehyde and acid (acetic fermentation) seems to be promoted by the presence of albuminous substances (though it is not by any means, like alcoholic fermentation, dependent on these); and, accordingly, wines containing such matters are much more liable to this fermentation than such as are free from them.

Aldehyde may be prepared by oxydizing alcohol by means of binoxyde of manganese and dilute sulphuric acid. It forms a colourless, very mobile liquid of extremely suffocating smell, the inhalation of its vapour causing spasms of the glottis. Its elementary formula is $C_2 H_4 O$. It boils at a temperature of 22° C., has a specific gravity of 0·8055, and mixes with water, alcohol, and ether in every proportion. When exposed to the action of the air, more particularly when diluted, it rapidly absorbs oxygen, and is converted into acetic acid. When boiled with silver salts, it reduces them to the metallic state, the silver being deposited as a bright mirror on the sides of the vessel. This reaction may be used to detect the presence of even minute quantities of aldehyde. Of course no other substances having a similar action on silver salts, as formic acid for example, must be present. Nascent hydrogen reconverts the aldehyde into alcohol ($C_2 H_4 O + H_2 = C_2 H_6 O$).

The presence of aldehyde in a wine, even in very minute quantity, is readily detected by its very peculiar and characteristic smell and flavour. If such a wine be neutralized by an alkali, to fix the volatile acids, and submitted to distillation through a well-cooled condenser, the aldehyde may be readily detected in the first portions of the distillate by its smell, flavour, its reducing action on silver salts, and by its easy conversion into acetic acid.

We have in this manner detected the presence of aldehyde in a variety of Greek wines (of these wines, indeed, it seems to form a characteristic feature), in one sample of Rhine wine, and one sample of Sauternes. The last two samples had been left standing in upright and badly corked bottles in an ordinary sitting-room, for nearly a year. This makes it probable that acet-aldehyde is not a normal constituent of sound wine, but that its presence must be looked upon as a decided mark of unsoundness.

CHAPTER VI.

THE ACIDS IN WINE.

List of acids—Varieties of tartaric acid.—Dextro-tartaric acid (ordinary tartaric acid).—Levo-tartaric acid.—Racemic acid (para-tartaric acid).—Malic acid.—Succinic acid.—Relations of the foregoing acids to each other.—Acetic acid.—Acetic ether.—Acetates of propyl, butyl, amyl, caproyl, &c. — Formic, propionic, butyric, valerianic, caproic, &c. acids.—Estimation of the quantity of acids in wine.—Estimation of tartaric acid and bitartrate of potash in wine.

LIST OF ACIDS.

THE acids hitherto distinctly recognized as present in wine are the following :—

Tartaric acid Malic ,, Tannic ,,	present in the grape.
Acetic acid Formic ,, Succinic ,, Carbonic ,,	produced during fermentation.

In addition to these, wine nearly always contains traces of some of the higher members of the fatty acid series, as propionic, butyric, and particularly œnanthic acid.

VARIETIES OF TARTARIC ACID.

We are acquainted with no less than six modifications of tartaric acid, most of which are almost identical in their chemical behaviour, but differ remarkably in some of their physical characteristics. They are—

Dextro-tartaric acid (ordinary tartaric acid).
Levo-tartaric acid.
Meta-tartaric acid.
Racemic acid (para-tartaric acid.
Inactive tartaric acid.
Meso-tartaric acid.

The empirical formula of all these acids is the same, viz. $C_4 H_6 O_6$. They are all dibasic, and form, therefore, two classes of salts and ethers, neutral and acid. The acid potassium salt of each is little soluble in water, almost insoluble in alcohol and ether.

One of the most characteristic properties of the two first acids is their action on polarized light; they possess the power of turning the plane of this light the first to the right, and the second to the left. The last four have no action on polarized light.

Only the first, second, and fourth acids on the list have been found in wine.

Tartaric acid has been prepared artificially in a variety of ways, some of which are of considerable theoretical interest. Sugar of milk, or gum, when boiled for some time with dilute nitric acid, yields a considerable quantity of tartaric acid identical in its properties with ordinary or dextro-tartaric acid. A small quantity of racemic acid is formed simultaneously. Mannit and dulcit treated in like manner, yield racemic acid; sorbin yields racemic, dextro-tartaric, and meso-tartaric acid. Mucic acid gives racemic acid; dibromosuccinic acid, when boiled with excess of lime-water, or its silver salt, when boiled by itself, yield tartaric acid. The acid thus obtained, however, while optically inactive, is not identical with racemic acid, for its lime salt is more soluble in boiling water than the corresponding racemate, and from this solution the salt crystallizes in needles with three molecules of water of crystallization, the racemate of lime under these circumstances crystallizing with four molecules of water. Moreover, the acid made from dibromosuccinic acid cannot be split into the two components of racemic acid. Monobromomalate of soda, when boiled with excess of lime-water, also yields tartaric acid. This monobromomalic acid has not yet, however, been obtained from malic acid.

Dextro-Tartaric Acid (ordinary Tartaric Acid).

Tartaric acid exists in the juice of the fruit of many plants, as tamarinds, mountain ash, mulberries, pine-apples, and others.

The largest quantities, however, are found in the juice of the grape. It is usually prepared from argol or crude cream of tartar, which is deposited in reddish crusts in the interior of the casks in which the must has fermented or rested after fermentation. This crude salt is decomposed by boiling with chalk, when a precipitate of tartrate of calcium is produced, whilst neutral tartrate of potassium remains in solution ; this latter is mixed with chloride of calcium, when a further quantity of tartrate of calcium is thrown down. Both these portions of tartrate of calcium are decomposed by diluted oil of vitriol, the resulting insoluble sulphate of calcium (gypsum) is removed by filtration or decantation, and the clear solution of tartaric acid thus obtained is evaporated to crystallization.

Tartaric acid crystallizes in large colourless, transparent prisms, belonging to the oblique prismatic system ; the crystals generally are unsymmetrical by the occurrence of hemihedral faces ; they contain no water of crystallization. When gently heated, the crystals become electrical, the two ends showing opposite electricity ; during the subsequent cooling of the crystal this polarity is reversed. The crystals have a specific gravity of 1·75, and a very sour, but not disagreeable, taste ; they dissolve readily in water, requiring only a little more than one-half their weight of cold, and still less of boiling, water for solution ; the acid is also soluble in alcohol, but insoluble in ether. This solution turns the plane of polarization to the right. The amount of rotation is not proportional to the quantity of acid in solution ; it is relatively greater in dilute solutions, and becomes less so as the concentration of the solution increases.

As before stated, tartaric acid is a dibasic acid, forming two classes of salts and ethers ; the salts also turn the plane of polarization to the right ; their crystals nearly always show hemihedral faces. The acid potassium salt ($K\,H, C_4\,H_4\,O_6$) occurs in the juice of grapes and in wine from which it is thrown down on the addition of alcohol. All the salts are readily produced by the partial or complete neutralization of the acid, or by the precipitation of a soluble salt by means of a salt of a metal forming with tartaric acid an insoluble compound.

The acid tartaric ether (C_2H_5, H, $C_4H_4O_6$) also occurs in wine, being generally formed in any mixture containing alcohol and tartaric acid—very slowly in the cold, more rapidly on heating. If absolute alcohol and dry crystallized tartaric acid are heated together, or are allowed to stand for a sufficient length of time, and the water formed during the reaction is removed, all the tartaric acid may be converted into the ether; but if water be present, a certain amount of acid remains in the free state, the proportion of such being the greater the more water is present.

Levo-Tartaric Acid.

This acid is not found in wine in the free state, but only in combination with ordinary tartaric acid, forming racemic acid. It can be obtained from racemic acid in a manner to be described under the head of that acid. Nearly all its chemical characters are identical with those of ordinary tartaric acid, but its optical properties are different; for, whereas the first acid turns the plane of polarized light to the right, the latter turns it, exactly to the same amount, to the left. This optical character is not, however, without influence on some of its physical and chemical properties: thus, although both acids crystallize in the same system, and both show hemihedric faces, these faces occur at opposite sides of the crystal; one crystal being, so to speak, the reflection of the other, they are incongruent-hemihedrical.

Ordinary tartaric acid, which turns polarized light to the right, shows these hemihedral faces on the right side of the crystal, whilst the crystals of levo-tartaric acid have them on the left side. Both acids, again, although identical in chemical characters in relation to substances not having the power of circular polarization, show considerable difference when brought in contact with substances having this power. Thus, ordinary bitartrate of ammonium readily combines with the acid ammonium salt of optically active malic acid, forming an easily crystallizable double salt; levo-tartaric acid, on the other hand, cannot be made to form such a salt. Again, ordinary tartaric acid unites readily with asparagin; levo-tartaric acid does not. This difference of the two acids may be used, as we shall see, in separating racemic acid into its two constituents.

Racemic Acid (*Para-Tartaric Acid*).

This acid is found in small quantities in nearly all crude tartar, but more particularly in tartar from Italy. The mother liquor obtained in the refining of crude tartar is precipitated by chalk; the insoluble salt thrown down is decomposed with sulphuric acid, and the liberated acid allowed to crystallize. These crystals are then left exposed to the air, when the crystals of racemic acid effloresce, and are easily separated from the transparent crystals of tartaric acid.

Racemic acid crystallizes in doubly oblique rhombic prisms (triklinometric), containing a molecule of water of crystallization ($C_4H_6O_6 + H_2O$). The crystals show no hemihedric faces: they effloresce slowly in dry air at ordinary temperature, rapidly at a temperature of 100°. It is not so soluble in water as tartaric acid: 1 part of acid requires 5·7 parts of water at 15°: it is also less soluble in alcohol, 1 part requiring 48. The solution has no action on polarized light. It gives a precipitate with chloride of calcium, or even gypsum, and thus differs from tartaric acid, which yields a precipitate with the former only after careful neutralization, and is not precipitated at all by the latter reagent.

The precipitate produced by a calcium salt in a salt of tartaric acid is soluble in acetic acid; the corresponding racemate is insoluble. The salts of racemic acid, like the acid itself, show no hemihedric faces; in other respects they closely resemble the tartrates. Very remarkable is the behaviour of the racemate of sodium and ammonium. If this salt is allowed to crystallize, it yields two kinds of crystals, all being hemihedric, but some having the hemihedral faces to the right, others to the left. When these crystals are separated, each variety can be recrystallized without altering its form. The crystals, having the hemihedral faces on the right, yield an acid identical with ordinary tartaric acid, turning the plane of polarized light to the right; the crystals having the hemihedral faces on the left yield an acid turning the plane to the left, but having the same composition and nearly the same chemical properties, as the right-turning tartaric acid, and are levo-tartaric acid. In a supersaturated solution of the racemate of potassium, the introduction of a crystal of ordinary tartrate of potassium induces the crystallization of this latter salt, whilst a crystal of the levo-tartrate produces a crystallization of the levo-tartrate solely. If concentrated solutions of ordinary and levo-tartaric acid are mixed, a considerable rise in temperature is observed, and crystallized racemic acid is produced.

MALIC ACID.

Malic acid ($C_4H_6O_5$) is one of the most widely diffused organic acids; it is found either free or in combination with potassium, calcium, magnesium, or organic bases, in very many plants, particularly in fruit, as apples, cherries, plums, and grapes, the berries of the mountain ash, &c.; the latter, containing it in the greatest quantity, are generally employed for its preparation. The juice pressed from the unripe berries is heated to boiling and strained; the clear juice is then nearly neutralized with milk of lime, and again boiled for some time. Neutral malate of lime is precipitated, which is collected, washed, and dissolved in warm dilute nitric acid (one part of acid to ten of water). On cooling, large crystals of acid malate of lime are deposited. These crystals may be purified by repeated crystallization, and then dissolved in hot water and precipitated with acetate of lead. The lead salt thus obtained may then be decomposed, either by sulphuretted hydrogen, or by boiling with dilute sulphuric acid, and the aqueous solution of malic acid produced evaporated to crystallization. According to another mode of preparation the clarified juice is precipitated by acetate of lead, the precipitate collected and washed with cold water; it is then boiled with water and again filtered; on cooling, the solution deposits crystals of malate of lead, which are decomposed as before. Malic acid crystallizes with difficulty, generally, in masses consisting of needles radiating from a centre. The crystals are very deliquescent, and are soluble in water and alcohol, but very slightly in ether. Solutions of malic acid turn the plane of polarized light to the left; solutions of its salts, however, turn it sometimes to the right, sometimes to the left.

Malic acid has been obtained from asparagin, or aspartic acid, by the action of nitrous acid, under evolution of nitrogen and water.

$$\underset{\text{Asparagin.}}{C_4 H_8 N_2 O_3} + N_2 O_3 = \underset{\text{Malic acid.}}{C_4 H_6 O_5} + 2 N_2 + H_2 O.$$

$$\underset{\text{Aspartic acid.}}{2 C_4 H_7 NO_4} + N_2 O_3 = \underset{\text{Malic acid.}}{2 C_4 H_6 O_5} + 2 N_2 + H_2 O.$$

If asparagin, or the optically active variety of aspartic acid, be taken for this reaction, the resulting malic acid is optically active; but if optically inactive aspartic acid is employed, the malic acid obtained is also optically inactive. Malic acid has also been prepared artificially by the action of oxyde of silver on a hot solution of monobromosuccinic acid; a silver salt of this acid is first formed, which at a boiling temperature, and in presence of an excess of silver oxyde, is rapidly decomposed into bromide of silver and malic acid.

$$\underset{\text{Monobromosuccinate of silver.}}{2 (Ag_2 C_4 H_3 Br O_4)} + Ag_2 O + H_2 O = \underset{\text{Malate of silver.}}{2 (Ag_2 C_4 H_4 O_5)} + 2 Ag Br.$$

From malate of silver the acid itself is obtained by precipitating the silver with sulphuretted hydrogen. The acid thus obtained seems to be optically inactive.

The optically inactive variety of malic acid has not yet been found in vegetables.

Malic acid is a dibasic acid, and gives rise, therefore, to two classes of salts and ethers, acid and neutral. The neutral and acid potash salts are soluble in water, alcohol, and alcohol-ether, and hence afford a means of separating this acid from tartaric acid. The lime salt is also soluble in water; it is, however, in great part precipitated from the aqueous solution by long boiling. It is thrown down immediately on addition of alcohol. As regards formation of ethers the acid behaves like tartaric acid.

SUCCINIC ACID.

Succinic acid ($C_4 H_6 O_4$) is found in amber, some lignites, in the turpentine from several varieties of pines, in several other plants, and in some parts of the animal organism.

It is a frequent product of the oxydation of organic substances, more particularly the fats and fatty acids. It is also produced during the fermentation of various substances, as asparagin, malic acid, sugar, &c., and is therefore always found in small quantity in wines. Grape sugar, during fermentation, yields about 0·5 per cent. of its weight of succinic acid. Malic and tartaric acids may also be directly reduced to succinic acid by the action of hydriodic acid.

$$\underset{\text{Malic acid.}}{C_4 H_6 O_5} + 2 H I = H_2 O + I_2 + \underset{\text{Succinic acid.}}{C_4 H_6 O_4}.$$

Succinic acid has been prepared artificially by the following synthetical processes. An alcoholic solution of ethylenic cyanide is boiled for some time with hydrate of potassa, whereby ammonia is evolved and succinate of potassium produced :

$$\underset{\text{Ethylenic cyanide.}}{C_2 H_4 2 C N} + 2 K H O + 2 H_2 O = 2 N H_3 + \underset{\text{Succinate of potassium.}}{C_4 H_4 K_2 O_4}.$$

Or cyanopropionic acid is treated with potash, ammonia is evolved, and succinate formed :

$$C_3 H_5 (C N) O_2 + K H O = C_4 H_4 K_2 O_4 + N H_3.$$

Succinic acid is usually prepared either by the distillation of amber or the fermentation of malate of lime.

A glass retort is filled to about $\frac{3}{4}$ with pieces of amber and gradually heated in a sand-bath. The products which distil over are collected in a receiver. The process is ended when the melted mass no longer froths up, and does not disengage any more white fumes. The distillate consists of succinic acid, which is partly solid, partly dissolved in the water formed during the dry distillation, and a yellow, strongly-smelling oil. The whole distillate is heated to boiling, filtered whilst hot to eliminate the oil, and allowed to crystallize. This impure acid is boiled for half an hour with four times its weight of ordinary nitric acid, crystallized from the acid liquid under constant stirring, collected, washed with water and once more crystallized, when it is obtained perfectly pure.

One part of malate of lime, three parts of water, and one-twelfth part of cheese are allowed to ferment at a temperature varying between 15° and 30°, during from eight to fourteen days. Carbonic acid is evolved, and a granular double salt of carbonate and succinate of calcium is produced. This double salt is decomposed with dilute sulphuric acid; the acid is first admixed in measured quantities, as long as any effervescence is produced, whereupon the same quantity as that which has already been used is yet added, the whole boiled for some time, filtered and evaporated to crystallization, the acid first obtained being purified by repeated crystallizations. Three pounds of malate of lime yield one pound of pure succinic acid. During this fermentation much acetic acid is also formed; the changes effected may be represented by the following equations:—

$$\underset{\text{Malic acid.}}{3\,C_4H_6O_5} = \underset{\text{Succinic acid.}}{2\,C_4H_6O_4} + \underset{\text{Acetic acid.}}{C_2H_4O_2} + 2\,CO_2 + H_2O.$$

Succinic acid crystallizes in large colourless rhombic or six-sided plates or prisms, belonging to the monoklinometric system. It is soluble in 5 parts of water at 16°, and in 2·2 parts of boiling water; somewhat less soluble in alcohol, and but slightly soluble in ether. When heated, it begins to sublime slowly at 140°, melts at 180°, and boils at 235°, the greater part splitting up into water and succinic anhydride. It is one of the most stable of organic acids; it can be heated with nitric, sulphuric, aqueous solution of chromic acid and with hydrochloric acid and chlorate of potassium, without undergoing alteration. When heated with bromine and water in sealed tubes, mono- and dibromo-succinic acid are produced according to the proportion of water employed.

Succinic acid is dibasic, and generally forms two classes of salts and ethers; with some bases, as for example potash, it forms, however, three kinds of salts:

$$\underset{\text{Neutral.}}{C_4H_4K_2O_4} \qquad \underset{\text{Acid.}}{C_4H_5KO_4} \qquad \underset{\text{Super acid.}}{C_4H_5KO_4 + C_4H_6O_4}$$

The salts with the alkalies or ammonium are soluble; those with the alkaline earths insoluble, or difficultly soluble in water. Solutions of a neutral succinate of an alkali give, with a neutral solution of a ferric salt, a gelatinous red-brown precipitate of basic succinate of iron. Salts of manganese are not thus precipitated, and may, by means of this immunity, be separated from the iron.

The presence of succinic acid in wine may be demonstrated in the following manner:—Half a litre of wine is decolorized by shaking it with 40 grms. of animal charcoal, filtered, and the charcoal well washed with cold water. Filtrate and wash-water are then carefully evaporated nearly to dryness on a water-bath, and the drying is finished under the air-pump. The dry residue is then repeatedly extracted with a mixture of one part of alcohol of from 90 to 92 per cent. strength, and two and a half parts of rectified ether. From this extract the ether is distilled off in a water-bath, and the evaporation completed in an open dish; the residue thus obtained is neutralized exactly with clear lime-water, and again carefully evaporated to dryness, also on a water-bath: from this residue the glycerine is extracted with ether-alcohol. The remainder is chiefly succinate of calcium, which may further be purified from some extractive matter and a non-crystallizable limesalt by digesting it for twenty-four hours with spirit of 80 per cent. The residue is then nearly pure succinate of calcium; it may be collected on a weighed filter, dried and weighed. One litre of wine contains from 1 to 1·5 grms. succinic acid.

RELATIONS OF THE FOREGOING ACIDS TO EACH OTHER.

The three acids, succinic, malic, and tartaric, are easily convertible into each other. Thus, tartaric acid, when heated with hydriodic acid, is reduced first to malic, and then to succinic acid; succinic acid, on the other hand, can be readily oxydized to malic and tartaric acids. The formulæ of the three acids—

$C_4H_6O_4$, succinic, $C_4H_6O_5$, malic, $C_4H_6O_6$, tartaric—

show that the second and third acid have each one atom of oxygen more than the preceding. These relations are, perhaps, expressed most clearly in the formulæ of Kolbe. He regards succinic acid as a double atom of carbonic acid, in which one atom of oxygen (one of the two outside the radicle carbonyl) is replaced by ethylen, thus:

$$\underset{\text{Carbonic acid.}}{O_2 \left\{ \begin{matrix} CO \\ CO \end{matrix} \right.} \qquad \underset{\text{Succinic acid.}}{O \left\{ \begin{matrix} CO \\ CO \end{matrix} \right\} C_2 H_4 + H_2 O.}$$

If, then, we replace one or two atoms of the hydrogen in the ethylen by hydroxyl, we obtain malic and tartaric acid respectively.

$$\underset{\text{Malic acid.}}{O \left\{ \begin{matrix} CO \\ CO \end{matrix} \right\} \left\{ \begin{matrix} C_2 H_3 \\ H O \end{matrix} \right. + H_2 O} \text{ and } \underset{\text{Tartaric acid.}}{O \left\{ \begin{matrix} CO \\ CO \end{matrix} \right\} \left\{ \begin{matrix} C_2 H_2 \\ H O \\ H O \end{matrix} \right. + H_2 O.}$$

A replacement of the same hydrogen by bromine, gives us mono- or dibromo-succinic acid.

$$O \left\{ \begin{matrix} CO \\ CO \end{matrix} \right\} \left\{ \begin{matrix} C H_3 \\ Br \end{matrix} \right. + H_2 O \text{ and } O \left\{ \begin{matrix} CO \\ CO \end{matrix} \right\} \left\{ \begin{matrix} C H_2 \\ Br_2 \end{matrix} \right. + H_2 O.$$

Although all three acids are dibasic, that is, contain two atoms of hydrogen replaceable by basic radicles, and forming, therefore, two classes of salts, malic acid contains a third atom of hydrogen, and tartaric acid a third and fourth atom which can be replaced by acid radicles, and under some circumstances also by basic radicles. The compounds however in which these hydrogen atoms are thus replaced differ materially from ordinary salts, and this hydrogen has accordingly been distinguished as alcoholic hydrogen. Malic acid may thus appear as a dibasic acid and a monodynamic alcohol, whilst tartaric acid is a dibasic acid and a didynamic alcohol.

ACETIC ACID.

Acetic acid ($C_2 H_4 O_2$) is found in small quantity, either free or in combination, in the juices of some plants and animals; it is formed by a variety of processes of oxydation or destructive distillation of organic substances, and has also been produced by several synthetical methods. The chief sources of its production are the oxydation of ordinary alcohol or the destructive distillation of wood. Ordinary or ethylic alcohol may be oxydized into acetic acid in several ways; most conveniently by heating it with bichromate of potash and sulphuric acid, or by bringing it in contact with substances having the power of condensing oxygen on their surfaces, which oxygen is transferred to the alcohol without these substances suffering any change themselves, as for example wood-shavings or platinum black. This process of oxydation may be assumed to take place in two periods: in the first, two atoms of hydrogen are removed from the alcohol, so that water and aldehyde are produced; in the second, this aldehyde absorbing one atom of oxygen is converted into acetic acid.

$$\underset{\text{Alcohol.}}{C_2H_6O} + O = \underset{\text{Aldehyde.}}{C_2H_4O} + H_2O.$$

$$\underset{\text{Aldehyde.}}{C_2H_4O} + O = \underset{\text{Acetic acid.}}{C_2H_4O_2}.$$

If the oxydation takes place energetically, and if plenty of oxygen is present, the intermediate product, aldehyde, is either not formed at all or only in small quantity; but if the oxydation takes place less energetically, or if the supply of oxygen is limited, aldehyde is produced in large quantity. The most important method of oxydizing alcohol on a large scale is the conversion of alcoholic liquids into dilute acetic acid or vinegar by the so-called acetous fermentation. Pure alcohol or pure mixtures of alcohol and water do not become oxydized by simple exposure to air. If, however, a diluted spirit, of about 10 per cent. strength, contains albuminous matter, and in addition is mixed with some already formed vinegar, acetous fermentation is rapidly set up. Under these circumstances a small fungus (*Mycoderma aceti*) begins to grow on the surface of the liquid, and by its action the alcohol is converted into acetic acid. In what manner the plant acts is not known, but somehow it transfers the oxygen of the atmosphere to the alcohol. As the presence of oxygen is necessary for this action, the plant acts only on the surface of the liquid; and in order to convert a large quantity of alcohol into acetic acid, the liquid should offer a large surface to the air. The mycoderma, moreover, cannot live in strong alcohol, and it can therefore convert only weak spirit, not much exceeding 10 per cent. alcoholic strength, into acetic acid. The temperature of the alcoholic fluid to be converted into vinegar should not fall below 22° or rise above 37° C.

For operations on a large scale the above conditions are secured by filling large vats provided with false perforated bottoms with flat pieces of wicker-work or wood-shavings. A vat thus newly filled is infused for several days with partially finished vinegar. The weak alcoholic liquid to be converted into vinegar (wine or beer already partially spoiled, or simply fermented smallwort) is then poured upon the top of the wicker-work, care being taken to distribute it evenly over the surface. It trickles down over the wicker and comes in contact with the air passing upwards through the vat, and during its passage down is converted into vinegar: these vats are placed in rooms kept at the temperature above given. A vat, when in active work, generates a considerable amount of heat, and its temperature is always higher than the temperature of the place in which it stands: this higher internal temperature considerably facilitates the passage of a current of air through the vat. When in fair working, the vat produces almost nothing but acetic acid; if, however, either the temperature is not the right one, or the supply of air insufficient, aldehyde is formed in greater or lesser quantity. The weak vinegar thus at first obtained may be made stronger by a further addition of alcohol, and a second passage through the vats; it may in this manner be brought up to a strength of 12 or 15 per cent. of acetic acid. If the alcoholic liquid employed in such a vat is free from albuminous matters, it is converted into vinegar by simple oxydation, without the intervention of the mycoderma, and even in the course of twenty years of constant use, no fungus is deposited on the wood-shavings in the vat. If, however, the alcoholic solution contains albuminous matter, the *Mycoderma aceti* makes its appearance.

Must, after partial fermentation, contains many of the elements favourable to the production of vinegar. Where the must ferments in open vats it exposes a large surface to the atmosphere, which is further increased by the thick froth covering it, or, as is often the case with red wines, by the skins and stalks of the grapes which float on the top. In most wine-producing countries, however, the temperature prevailing during the time of fermentation is not high enough to favour acetous fermentation; and, moreover, during the greater part of such fermentation the carbonic acid constantly produced and escaping at the surface prevents the free access of air. In all moderately warm countries it requires, therefore, but slight attention to prevent an excessive production of acetic acid, and in the wines produced there the quantity usually ranges from between 0·5 to 1·5 per 1,000. In warm countries and seasons, however, and in all cases where the skins are allowed to ferment with the must, great care is requisite to prevent the formation of vinegar, and frequently the fermentation of the must has to be stopped by the addition of alcohol, in order to limit as much as possible the time during which the wine has to be kept in open casks or vats. If the fermentation of the must has been complete, and if originally there has been a proper proportion between the quantity of sugar and the albuminous matter, the latter will be almost completely removed; and such wine is little, if at all, liable to turn sour. As long, however, as an appreciable quantity of albuminous matter is left, the wine is liable to change. It has been stated above that the addition of acetic acid or vinegar to wine considerably favours the growth of the mycoderma, and, as a parallel to this, it is found that the rapidity with which wine is converted into vinegar increases to a certain extent with the increasing amount of acetic acid. If once, therefore, the quantity of acetic acid present has reached a certain amount, its further production will go on at a greatly increased rate, and the wine can no longer be kept in vessels to which air has access without turning sour entirely. If, as mentioned above, the oxydation of the alcohol takes place under conditions where there is but a limited supply of oxygen, it often stops short at aldehyde; the same is sometimes the case in wines which have been kept in vessels allowing a very slight access of atmospheric air. We have, for example, found notable traces of aldehyde in one bottle of Sauternes and one of Geisenheimer-Rothenberger; in both cases the bottle had stood upright, in a moderately warm room, for nearly a year, and, although full and corked, air had found its way into the bottle enough to oxydize some of the alcohol into aldehyde. Wine bottles should, therefore, always be laid on their side, so as to keep the cork covered with wine, and thus prevent this diffusion of air through the cork. In several of the Greek wines which we have examined, notable traces of aldehyde, and a very considerable amount of acetic acid, were detected, showing the effects of carelessness at some stage or other of their production.

The highest-amount of acetic acid found in 36 samples of Rhine wine, and other German wines, amounted to 1·78 per thousand, the lowest being only 0·36 per thousand; while in 7 samples of Greek wines the acetic acid varied between 1·53 and 3·63 per thousand.

Acetic acid in a pure state may be obtained from vinegar, produced by the acetous fermentation of diluted spirit, in the following manner. The vinegar is first submitted to distillation, which is continued until empyreumatic products begin to come over; this latter result may be obviated to a considerable extent by putting pieces of charcoal into the still. This distilled acid is then neutralized by an alkali, soda for example, and evaporated to dryness. The resulting acetate of soda is purified by recrystallization, dried, put into a retort, and after the addition of strong sulphuric acid the liberated acetic acid is distilled off. The first portions of distillate generally contain water, and the following portions are contaminated with sulphurous acid and small quantities of sulphate of soda. It is, therefore, advisable to add some dry binoxyde of manganese to the distillate for the purpose of oxydizing the sulphurous acid, and then redistil it. The first third of the distillate is rejected; the last two-thirds only are collected. This portion is then cooled to the temperature of freezing water, when the greater part of it crystallizes; the mother liquor is drained off, and the crystals after melting are made to crystallize once more. The mother liquor from this second crystallization being removed, the crystals remain solid up to a temperature of 15°. This same solid acetic acid may also be obtained in the following manner. Acetate of potash is put into a retort, a slight excess of moderately strong acetic acid added, and, after the introduction of a thermometer, heat is applied. At first a very weak acid passes over, after which the temperature rises rapidly without much liquid distilling over. When the temperature has risen to 200°, the binacetate, which had been formed at the beginning, begins to be decomposed, and from this point up to a temperature of 300° pure acetic acid distils over.

Very considerable quantities of acetic acid are also obtained among the products of the dry distillation of wood. From the crude product the acid may be obtained by distillation, neutralization with an alkali, decomposition of the resulting acetate by an acid, &c.

Acetic acid has also been prepared synthetically by a variety of processes, some of which possess considerable theoretical interest. Thus by the action of carbonic acid on sodium methyl, sodium acetate is formed:

$$\underset{\text{Sodium methyl.}}{Na\,C\,H_3} + C\,O_2 = \underset{\text{Acetate of sodium.}}{C_2\,H_3\,Na\,O_2}.$$

By acting with potassa on cyanide of methyl—

$$C\,H_3\,C\,N + K\,H\,O + H_2\,O = C_2\,H_3\,K\,O_2 + N\,H_3.$$

Lastly, acetic acid has been prepared synthetically even from the elements themselves. Carbon and sulphur unite at a red heat, forming disulphide of carbon ($C\,S_2$). By the action of chlorine on this disulphide of carbon, chloride of carbon ($C_2\,Cl_4$) is produced, and this in the presence of water is transformed by chlorine into trichloracetic acid ($C_2\,Cl_3\,H\,O_2$); and ultimately this is converted into acetic acid by the action of zinc or sodium amalgam. The same synthesis may be accomplished in a different manner. Hydrogen passed over the intensely ignited carbon points of the electric light combines directly with the carbon and forms acetylen ($C_2\,H_2$). This acetylen enters into combination with suboxyde of copper, yielding acetylite of copper, from which the acetylen may be liberated again by hydrochloric acid. If this liberation takes place in presence of nascent hydrogen, the acetylen takes up

N 2

two atoms of hydrogen and produces ethylen (C_2H_4). This ethylen can be converted into alcohol, and the latter into acetic acid.

Acetic acid is a colourless liquid, of a strongly acid taste and smell; it can be mixed in every proportion, with water, alcohol, and ether. In moist air it fumes slightly and readily attracts moisture. It boils at a temperature of 118° C., but evaporates at temperatures considerably below this, and solidifies at a temperature a little below 16°, forming large colourless tabular crystals, which melt between 16° and 17° C. The specific gravity of the solid, glacial, acetic acid is 1·10 at 8·5° C., that of the liquid 1·0635 at 16° C. The vapour density is 2·090 when estimated at a temperature of 240° C. or upwards, below this temperature the vapour density is considerably higher; the calculated theoretical density is 2·076. The pure glacial acetic acid or hydric acetate ($C_2H_4O_2$) does not redden dry litmus paper; the addition of water, however, causes at once a strong reddening. The same acid acts as a strong caustic on the skin, raising on the softer parts, like formic acid, white blisters, which produce painful, slowly healing wounds. When mixed with water, a slight elevation of temperature is produced, contraction taking place at the same time. The addition of water to the crystallizable acid causes, therefore, an increase in the specific gravity, which rises to the maximum of 1·0735 in the mixture containing 80 parts by weight of acid to 20 parts of water; on the addition of more water the specific gravity gradually decreases. A mixture of 54 parts of acid with 46 parts of water has the same specific gravity as pure acetic acid, and on further dilution the specific gravity continues to decrease. For these reasons it is impossible to estimate the strength of an aqueous solution of acetic acid by its specific gravity alone.

Acetic acid is a monobasic acid, forming generally but one class of salts, and always but one class of ethers. With some bases, however, it is capable of forming acid salts, as the binacetate of potassium ($C_2H_3KO_2, C_2H_4O_2$); whilst with some bases, as lead and copper, it has a great tendency to form basic salts. All the neutral acetates are soluble in water, and mostly also in alcohol. Most of the salts crystallize readily, and may easily be prepared either by dissolving the metal in the acid, or by neutralizing the acid by means of the oxyde or carbonate of the metal.

Metallic lead and copper are not dissolved even by boiling acetic acid, but are dissolved readily with formation of basic salt when at the same time exposed to the action of atmospheric air. The salts thus formed are strongly poisonous, and any articles of food containing acetic acid, or which readily turn sour, should therefore not be kept for any length of time in copper vessels, though they may be boiled in them without danger if the vessel is perfectly clean and bright.

Tests for Acetic Acid.

The presence of acetic acid, or an acetate, may be recognized by heating the liquid to be tested with sulphuric acid and alcohol, when acetic ether is produced and easily recognized by its agreeable, refreshing odour; or, without the addition of alcohol, the liberated acetic acid may be recognized by its characteristic smell. Solutions of neutral acetates give a more or less intense blood-red coloration on the addition of perchloride of iron, which is destroyed by the addition of strong mineral acids as well as by boiling, basic acetate of sesquioxide of iron being thrown down in the latter case. If the acetic acid, as is the case in wine, is mixed with a great many other substances, it should be separated from them by distillation, and the tests applied to the distillate, neutralized, if necessary, by potash or ammonia.

Very minute traces of acetic acid may be recognized in the following manner. If the acid is already in combination with an alkali, the test may be applied directly, but if such is not the case the acetic acid must be separated by distillation with somewhat diluted sulphuric acid, the acid distillate neutralized by carbonate of potassium and evaporated to dryness. This dry residue is mixed intimately with a little finely pulverized arsenious acid, introduced into a glass tube and heated. The acetate and arsenious acid react on each other with formation of oxyde of kakodyl, easily recognized by its penetrating offensive odour. A second method for recognizing minute quantities of acetic acid consists in boiling the liquid suspected to contain free acetic acid, or the distillate obtained after the addition of sulphuric acid, with freshly precipitated carbonate of silver, filtering the hot solution and evaporating to a small bulk ; the last drops are then placed on a microscopic slide and allowed to cool, or, if necessary, allowed to evaporate spontaneously still further. The acetate of silver crystallizes in characteristic forms, and cannot easily be confounded with other crystals. It is advisable to compare the crystals with those produced by the evaporation of a few drops of a pure acetate of silver solution.

That the volatile acid of the wine is almost all acetic acid is readily proved by estimating its atomic weight. Several hundred grammes of the wine to be examined are carefully distilled nearly to dryness; some water is added to the residue and again distilled: these additions of water and distillations are repeated until the distillate coming over is no longer strongly acid. The entire distillate is then neutralized with carbonate of soda and evaporated to dryness on a water-bath. The residue is taken up in a little water acidulated with diluted sulphuric acid, and any hydrochloric acid it may contain precipitated by the careful addition of a little sulphate of silver solution. The liquid poured off the chloride of silver is then distilled, and the acid liquid neutralized with pure carbonate of baryta. The clear filtered solution is evaporated on a water-bath, the residue dried at a temperature of 115°, and weighed. It is then decomposed by sulphuric acid, and the resulting sulphate of baryta weighed after ignition. From these data the equivalent of the volatile acid is readily calculated. Pure acetate of baryta should contain 53·54 per cent. baryum.

Thus the acids from the following wines, when converted into the baryta salt, as above, yielded per cent. baryum :—

From Rauenthaler (£6 per ohm) . .	53·3 per cent. baryum.
From Rauenthaler (44*s*. doz.) . . .	53·6 ,, ,,
From Hattenheimer (£15 per ohm) . .	53·9 ,, ,,

The estimation of the baryum in the salt produced by the whole of the volatile acid, is not, however, in itself a perfectly reliable criterion of the purity of the acetic acid contained in it.

FORMIC, PROPIONIC, BUTYRIC, VALERIANIC, CAPROIC, ETC. ACIDS.

All these acids, together with acetic acid, belong to a series of homologous acids called fatty acids: this series runs parallel with the series of alcohols (ethylic series), from which they may be derived; each acid differs from its corresponding alcohol by containing two atoms of hydrogen less, and one atom of oxygen more.

SERIES OF FATTY ACIDS.

		Fusing-point.	Boiling-point.
Formic acid	$C\,H_2\,O_2$	+ 1°	100°
Acetic acid	$C_2\,H_4\,O_2$	+ 17°	117°
Propionic acid	$C_3\,H_6\,O_2$	——	141°
Butyric acid	$C_4\,H_8\,O_2$	below 20°	156°
Valerianic acid	$C_5\,H_{10}\,O_2$	——	175°
Caproic acid	$C_6\,H_{12}\,O_2$	+ 5°	198°
Œnanthylic acid	$C_7\,H_{14}\,O_2$	——	212°
Caprylic acid	$C_8\,H_{16}\,O_2$	+ 14°	236°
Pelargonic acid	$C_9\,H_{18}\,O_2$	+ 18°	260°
Capric acid	$C_{10}\,H_{20}\,O_2$	+ 27·2 (30°)	—
	——	——	—
	——	——	—
Melissic acid	$C_{30}\,H_{60}\,O_2$	+ 88°	—

Between formic and butyric acid the melting-point rises from + 1 to + 20; with caproic acid it falls again to + 5°, and between caproic and melissic acid it rises again from + 5° to + 88°, though not in any regular proportion to the atomic weight. The boiling-point, on the other hand, rises regularly with the atomic weight in such a manner that a difference of $C\,H_2$ in the composition corresponds very nearly to a difference of 19° in the boiling-point.

The acids which in the table stand above pelargonic acid are liquid at ordinary temperature, those below it are solid.

Similar, more or less regular, differences are found amongst all the physical and chemical characters of these acids. Thus, while the first four members of the series are soluble in water in every proportion, one part of valerianic acid requires 30 parts of water for its solution; and one part of caproic acid no less than 96 parts. The fatty acids of higher atomic weight are insoluble in water. If a mixture of several of these acids is partially neutralized by an alkali, and the mixture distilled, the acids of the highest atomic weight distil over first, those of the lower atomic weight remaining behind in combination with the alkali; or, if to a mixture of the salts of these acids a quantity of sulphuric acid be added, only sufficient to decompose a small quantity of them, and the mixture distilled, the distillate will contain only the highest member or members of the series; a further addition of sulphuric acid will liberate the next lower member, and so on down to the lowest. In this manner we are able to separate, easily and completely, the higher from the lower members, and obtain any one of the members in a state of purity.

Thus, suppose we had a mixture of acetic and propionic acid: if we neutralize the whole, and then add just enough sulphuric acid to liberate the greater part, but not the whole of the propionic acid (or what comes to the same thing, add to the original acid mixture rather more alkali than would neutralize the acetic acid), and distil, the distillate will contain only propionic acid, whilst a mixture of propionate and acetate remains in the retort. If now a further quantity of sulphuric acid, more than enough to liberate the remaining propionic acid, be added, and the mixture again distilled, this second distillate will consist of a mixture of propionic and acetic acid, a pure acetate remaining behind, from which, of course, the pure acetic acid can be liberated by a third addition of sulphuric acid and distillation. Even from a mixture of unknown composition we may, by a series of such fractional distillations, gradually separate the different acids.

Most of these fatty acids, with the exception of the higher members, occur very frequently among the products of decomposition of more complex organic substances, more particularly among the products of oxydation. Thus formic acid is produced in considerable quantity by the oxydation of starch, sugar, &c. Among the products of the oxydation of albuminous substances are found formic, acetic, propionic, butyric, valerianic, and caproic acid; the same acids are also found among the products of oxydation of the higher fatty acids, or their combinations with glycerine (fats). The gradual oxydation of the albuminous substances of the must and wine, or of the fatty substances found in the kernels of the grape, is most probably the chief source of these acids in wine. Some acids of the series are also produced by certain kinds of fermentation; and lastly, some of them, as acetic acid, are produced by the destructive distillation of sugar or woody fibre. Many of the lower members of the series have also been obtained by synthetical processes analogous to those given under the head of Acetic Acid.

The only acid of the series, besides acetic acid, which has been recognized as certainly present in many wines, is formic acid; of the others we know only that they are represented in wine by one or more of their number, though we do not know exactly by which.

Formic acid may readily be recognized in many wines by neutralizing the acid distillate with ammonia, evaporating to dryness, dissolving the residue in a small quantity of water, adding a drop of nitrate of silver, and boiling; if formic acid be present, a blackish brown precipitate of metallic silver will be produced. Nitrate of suboxyde of mercury is similarly reduced. If, however, the quantity of formic acid present is very small, we must separate it from the greater part of the acetic acid by fractional distillations, as above described. The portion of acid coming over after the last addition of sulphuric acid will contain the formic acid. By the same fractional distillation it is also easy to show the presence of some acid higher in the scale than acetic. For this purpose several litres of wine are distilled from a retort placed in a salt-water bath. To the residue in the retort water is added, and the distillation continued; this addition of water and distillation being repeated until the distillate is no longer strongly acid. It is, however, scarcely possible to drive over all the volatile acid, because the residue in the retort cannot be heated much above the temperature of boiling water without suffering decomposition. It will, therefore, be found that even after many additions of water and distillations, the distillate is still acid; we must then rest contented to obtain at least the greater part of the volatile acid, leaving, most probably, some portions of the higher acids in the residue. The whole of the distillate is then neutralized by carbonate of soda, and evaporated; the dry residue is dissolved in a little water, filtered, if necessary, and put into a retort; an excess of dilute sulphuric acid is then added and the mixture distilled. Should the acidified solution contain hydrochloric acid, it must be removed by the careful addition of sulphate of silver before distillation. The distillation may be conducted over an Argand burner, and can be continued nearly to dryness. It is, nevertheless, advisable to add water to the residue, and again distil; some pieces of tobacco pipe may also be placed in the retort with advantage. The acid distillate thus obtained is exactly neutralized by a standard solution of soda. The neutralized solution is again put into a tubulated retort, and a certain amount of standard sulphuric acid being added—say $\frac{1}{5}$, $\frac{1}{10}$, or $\frac{1}{20}$, of the amount of soda that was required to neutralize the whole of the acid—the mixture is distilled to dryness under the above precautions. Some water is then added to the residue in the retort, a further quantity of sulphuric acid introduced, and the mixture again distilled. This addition of acid and distillation is continued until the whole of the volatile acid has been liberated. All the distillates are, of course, collected separately; they are then neutralized with carbonate of baryum, filtered, evaporated to dryness, and the percentage of baryum contained in each portion is estimated. In this manner it is easy to demonstrate that wines generally contain some fatty acid of greater atomic weight than acetic, as well as acetic and formic acid. The smaller the first fraction of acid distilled over, the more probably will it consist of the highest member only, and the less will be the percentage of baryum contained in its salt; and if small quantities are distilled off successively until the baryta salt obtained from the distillate corresponds to acetic acid, some estimate of the quantity of the higher acid present may be got. If very large quantities of wine were thus treated, even the individual members of the series present might thus be isolated.

The following experiments made on three Rhine wines will illustrate the process :—

1. Three litres of Rauenthaler (costing £6 per ohm) were distilled, and treated as above described. Part of the second acid distillate was at once neutralized with carbonate of baryta and the baryum estimated; the rest of the volatile acid required 20 c. c. normal soda solution for neutralization. This neutral solution was put into a retort, and after the addition of 4 c. c. of normal acid, distilled; a further quantity of 12 c. c. of acid was added and again distilled; and lastly, 4 c. c. more acid was added and the distillation repeated. The three distillates were then neutralized with baryta and the baryum estimated.

Baryum salt of the mixed acids contained .	53·3 per cent. Ba.
,, ,, 1st fifth ,, .	52·8 ,, ,,
,, ,, 2d, 3d and 4th fifth ,, .	53·8 ,, ,,
,, ,, last fifth ,, .	53·9 ,, ,,

The last distillate was in this case free from formic acid.

2. Rauenthaler (price 54*s*. per doz.), treated as above, with this difference, that instead of $\frac{1}{5}$ only $\frac{1}{10}$ of the total amount of sulphuric acid necessary to liberate the whole acid was added at a time.

Baryum in salts of mixed acids	53·6 per cent.
,, ,, first $\frac{1}{10}$	51·7 ,,
,, ,, next $\frac{8}{10}$	53·6 ,,
,, ,, last $\frac{1}{10}$	55·7 ,,

The last distillate contained distinct traces of formic acid.

3. Hattenheimer (price £15 per ohm). Five litres of wine were distilled; the portion of volatile acid taken for the fractional liberation and distillation required 56 c. c. of normal soda. The first portion of acid added was only $\frac{1}{20}$ of the total required, before the second distillation $\frac{18}{20}$ were added, and, lastly, again $\frac{1}{20}$.

Baryum in salt of mixed acids	53·9 per cent.
,, ,, first $\frac{1}{20}$	46·3 ,,
,, ,, next $\frac{18}{20}$	54·1 ,,
,, ,, last $\frac{1}{20}$	56·3 ,,

The last distillate contained an appreciable quantity of formic acid.

In all cases the salt of the first fraction contains less baryum than corresponds to an acetate; the intermediate fractions contain almost exactly the proportion required by a pure acetate; the last fraction contains, in the two last cases, perceptibly more.

Formiate of baryum contains	60·18 per cent. Ba.		
Acetate ,, ,, ...	53·54	,,	,,
Propionate ,, ,, ...	48·22	,,	,,
Butyrate ,, ,, ...	43·87	,,	,,

In analysis 3, the baryta salt of the first $\frac{1}{20}$ contained less baryum than corresponds to the propionate, and must therefore have contained some acid still higher in the series; and it is probable that if a still smaller proportion had been distilled off, a yet smaller percentage of baryum would have resulted. As, however, the amount of baryta salt required to estimate the percentage of baryum with sufficient accuracy must not be too small, very large quantities of wine would be required to carry the separation of the volatile acids much further than in the last case.

ŒNANTHIC ACID.

This acid, the elementary composition of which is expressed by the formula $C_{14} H_{26} O_3$, has been discovered by Liebig and Pelouze in the ether to which wine owes its characteristic vinous smell. It may be obtained as follows:—Œnanthic ether is boiled with a solution of caustic potash, whereby alcohol is driven off, and œnanthate of potassium is produced. When all the alcohol has been expelled by boiling, the solution is acidified with dilute sulphuric acid, the oil which separates is washed thoroughly with hot water, and finally dried *in vacuo* over oil of vitriol. The pure concentrated acid thus obtained constitutes a soft, white solid, which melts a little over 13° C. into a tasteless, inodorous oil, soluble in alcohol and ether, but insoluble in water. It has a feeble acid reaction, and is readily soluble in caustic alkalies and alkaline carbonates with formation of the salts of these bases. The acid is dibasic, and forms two kinds of salts, acid and neutral.

ŒNANTHIC ANHYDRIDE.

When the acid is submitted to distillation, the greater part of it breaks up into water and anhydride ($C_{14} H_{24} O_2$). At first, a mixture of water and acid passes over; later, the anhydride distils by itself. The anhydride begins to boil at 260°, the temperature gradually rises to 293°, and the contents of the retort become slightly brown. It solidifies at a temperature of 31° C.

ESTIMATION OF THE QUANTITY OF ACIDS IN WINE.

For the purpose of ordinary analysis it is sufficient to estimate the whole of the volatile acids as acetic acid. The fixed acids may be treated as if they were malic and tartaric only. Their quantitative determination may be accomplished in the following manner. 20 c. c. of wine are measured in a pipette and allowed to flow into a beaker. If the wine is coloured, about 100 c. c. of distilled water are added, to reduce the colour, and a few drops of an alcoholic tincture of logwood.[1] To this mixture a decinormal solution of caustic soda is now given from a burette divided into tenths of c. c. until the colour of the mixture changes from yellow, or brown to red. In some wines this change from yellow to red takes place promptly, and can be readily observed; in others, however, the colour passes gradually through brown, blue, green, &c., and never becomes actually red. In these cases it is impossible accurately to fix the point where sufficient alkali has been added, and then the following method is best adopted. The wine having been diluted and a few drops of logwood tincture added, the decinormal soda solution is poured in until a change in the colour becomes perceptible. At this stage a drop of the liquid in the beaker is taken out with a glass rod, and placed on a

[1] The logwood solution should be made from chips freshly cut from the solid block, and not from the chips of wood as used by dyers. It should not be kept for more than a few weeks, and during that time be placed in the dark, and not too much exposed to the air, otherwise it loses much of its delicacy.

slab of white porcelain by the side of a drop of tincture of logwood, in such a manner that the two drops are just in contact. The two drops will gradually mix; and as long as the liquid in the beaker is acid, the colour produced will be yellow, brown, or bluish green. As soon, however, as a very slight excess of alkali has been added, a distinct pink colour will result, which is best perceptible in the first few streaks of tincture passing across the drop of wine. This red colour, however, is shown only when a slight excess of alkali has been added; tincture of logwood being yellow when acid, brown when neutral, and red when alkaline. The excess of alkali necessary to produce the red colour is, however, very slight, provided that, as before recommended, only fresh tincture is employed. With a decinormal solution of soda, for example, 0·1 c. c. added to 50 c. c. of water is sufficient to produce the above-described reaction when the two drops are placed side by side on a white slab. It is therefore simply necessary to subtract, from the amount of alkali used, 0·1 c. c. for every 50 c. c. of diluted wine, to obtain the exact amount of alkali necessary for neutralization. With some care the amount of decinormal soda necessary to neutralize the acid of 20 c. c. wine, even if these had to be diluted to 100 or 150 c. c., on account of colour, can be estimated to within 0·1 c. c., equal to 0·00066 grm. of tartaric acid, or 0·0033 per cent.

The amount of alkali thus required represents the total amount of free acid present in the wine; and as a decinormal solution of soda is employed (a solution containing one-tenth of the equivalent weight of caustic soda expressed in grammes per litre, and consequently neutralizing one-tenth of an equivalent of a monobasic acid expressed in grammes per litre), it is only necessary to multiply the number of c. c. of alkali used by $\frac{1}{2000}$ of the equivalent of any acid to obtain the percentage of such acid present, in case 20 c. c. have been taken. Thus the equivalent of acetic acid being 60, and that of tartaric acid, as regards its neutralizing power, 75, we have merely to multiply the number of c. c. of decinormal soda used to neutralize the acid in 20 c. c. wines by 0·03 and 0·0375 respectively, to obtain the percentage of free acid present, expressed as either acetic or tartaric acid.

The total amount of volatile acid present is estimated as follows: — 20 c. c. of wine are placed in a small porcelain dish, evaporated on a water-bath, and heated for about half an hour after the evaporation has apparently ceased. The residue, which is generally a thick viscid fluid, is redissolved in water, and the amount of free acid left is estimated as before described. This free acid represents the total free fixed acid of the wine, and the difference between this and the first determination gives of course the total volatile acids present, as measured by their neutralizing power.

In case the wine contains much sugar or extractive matter, it may be of advantage to mix some pure powdered quartz with the wine previous to the evaporation, and so stir the mass well towards the end to facilitate the escape of the volatile acid. This will, however, but rarely be found necessary if the wine is evaporated in a shallow dish and upon an open water-bath. Too long heating of the residue should also be avoided, as it gradually loses in acidity, by changes which are not due to any escape of volatile acid. Thus, in two samples of Rhine wine, 20 c. c. of the wine itself required 15·6 c. c. and 13·8 c. c. d. n. soda. After evaporation and heating for one hour, 11·6 c. c. and 10·0 c. c. were respectively required, but the same samples required but 5·1 c. c. and 4·8 c. c. d. n. soda when the evaporated residue had been heated on a water-bath till its weight remained constant, which took about forty-eight hours. The acidity of the residue was still further diminished on drying the residue in an air-bath to 110° till the weight remained constant, when the residue from 20 c. c. of the above two wines required only 1·2 and 1·9 c. c. soda. The residues which had been heated for forty-eight hours on the water-bath took still twenty-four hours in the air-bath to become constant in weight.

It is almost impossible accurately to estimate the volatile acid by distillation and estimation of the acidity of the distillate, as even repeated distillation to dryness, and filling up again with water, fail to drive over all the volatile acid. The estimation of the fixed acid in the residue left in the retort would be still more unsatisfactory; for the acidity of the residue, when added to the acidity of the distillate, even after very careful distillation, never quite comes up to the total acidity of the wine, and may even fall very far short of it if the distillation has been continued a little too far. The latter accident is, however, almost unavoidable, if anything like the greater quantity of the volatile acid is to be distilled over.

In good sound wines the total amount of free acid ranges from 0·3 to 0·7 per cent.; wines with more than the latter amount of free acid are neither pleasant nor wholesome. Of the total acidity not more than about 0·15 per cent. should be due to volatile acid.

ESTIMATION OF TARTARIC ACID AND BITARTRATE OF POTASH IN WINE.

The bitartrate of potash, although slightly soluble in water, is almost absolutely insoluble in strong alcohol or a mixture of alcohol and ether. Upon this insolubility two methods for the estimation of the tartaric acid and bitartrate have been based. The first, proposed by Berthelot, and giving on the whole the most accurate results, is as follows:—20 c. c. of wine are mixed in a well-stoppered bottle or flask with 100 c. c. of a mixture of equal volumes of alcohol and ether; to another 20 c. c. of the wine a quantity of potash (sufficient to neutralize about one-fifth of the free acid of the wine) is added, together with 100 c. c. of the alcohol and ether mixture. Both bottles are then set aside for two or three days in a cool place; at the end of this time almost all the bitartrate of potash present in both bottles will have been deposited, sometimes in well-defined crystals. These precipitates are then collected on a filter, washed with alcohol-ether, introduced with the paper into a flask or bottle, and dissolved in distilled water, if necessary, with the aid of heat. The free acid present in these solutions is then estimated by a decinormal solution of soda as previously described.

These precipitates of bitartrate do not, however, represent the total amount of bitartrate present, because a small quantity remains in solution, amounting to about 0·004 grm., equivalent to 0·02 per cent. of bitartrate in the wine. These 0·004 grm. bitartrate of potash require 0·21 c. c. d. n. soda; which have to be added to the amount found. With this correction, the precipitate from the first 20 c. c. represents the bitartrate present in the wine; the precipitate from the second 20 c. c. contains the whole amount of the tartaric acid present. We have then simply to multiply the number of c. c. d. n. soda required to neutralize the precipitates, plus the necessary correction of 0·21 c. c., by 0·094 and 0·075 respectively, to obtain the percentage of bitartrate and of tartaric acid in the wine.

The second method, which also yields very satisfactory results, has been described by Nessler. The total free acid present is first estimated in 20 c. c. of the wine; 40 c. c. of the wine are then put into a flask and mixed with a sufficient quantity of absolute alcohol to amount to 150 c. c. The flask is then set aside for forty-eight hours; at the end of this time nearly all the bitartrate present will have been precipitated; 75 c. c. of the clear liquor are then taken off with a pipette, put into a beaker, and the free acid still present is estimated as usual. If no bitartrate had been precipitated, the amount of free acid in these 75 c. c. should of course be one-half of the free acid in the 40 c. c. of wine employed, and any deficiency in its acidity, in the case where bitartrate had been deposited, is the measure of the bitartrate present in 20 c. c. of the wine. The total amount of tartaric acid present is estimated thus: to 40 c. c. of wine enough of decinormal alcoholic potash is added exactly to neutralize 10 c. c. of wine, and the whole is then made up to 150 c. c. by absolute alcohol. After the lapse of forty-eight hours 75 c. c. of the clear liquid are taken off and their free acid is estimated; the amount of the deficiency, taking into consideration the 10 c. c. d. n. potash added, corresponds to the bitartrate present in the 20 c. c. of wine, or to half the amount of tartaric acid in 20 c. c. of wine.

A solution containing 0·5 per cent. of crystallized tartaric acid was made; 20 c. c. of it required 13·3 c. c. d. n. soda;

40 c. c. of this were then measured into a flask, 13·3 c. c. d. n. alcoholic potash was added, and the whole made up to 150 c. c.; after two days' standing, 75 c. c. of the clear liquid required, as the mean of several experiments, 0·15 c. c. d. n. soda, which represents the solubility of the bitartrate in the alcoholic liquid.

To 50 c. c. of this same solution 1 grm. citric acid was added, and then water up to 200 c. c.; 20 c. c. of this mixture required 17 c. c. d. n. soda. 40 c. c. of this solution were now mixed with 8·5 c. c. d. n. potash, and then with alcohol up to 150 c. c.; after two days' standing, 75 c. c. of the clear solution required 11·1 c. c. d. n. soda, or subtracting the above-stated correction for the solubility of the bitartrate (0·15 c. c.), 10·95 c. c., there should have been required 12·75. Deducting from this 10·95, there remain 1·8, which multiplied by two gives 3·6 c. c., the amount of d. n. soda required to neutralize the tartaric acid in 20 c. c. of the mixture. The rest of the 17 c. c. required to neutralize 20 c. c. of mixture is, therefore, due to citric acid. We have thus—

d. n. soda required to neutralize the $\bar{T}$, of 20 mixture,
Calculated : 3·32 c. c. = 0·124 per cent.
Found : 3·6 c. c. = 0·135 ,,
d. n. soda required to neutralize the $\bar{C}$,
Calculated : 13·68 c. c.
Found : 13·4 c. c.

showing that even in presence of a considerable excess of citric acid this process gives tolerable results.

(The tartaric acid solution first employed required 13·3 c. c. d. n. soda per 20 c. c. solution; 50 c. c. of this were diluted up to 200 c. c., and if no citric acid had been added 20 c. c. would now require only 3·32 c. c. d. n. soda; enough citric acid had, however, been added to bring the strength up to 17 c. c. d. n. soda, of which 3·32 c. c. being due to tartaric acid, 13·68 c. c. must have been due to citric acid.)

Both methods give rather accurate results, if the amount of tartaric acid present does not fall short of 0·05 per cent.; below this amount the results are inaccurate, inasmuch as the acidity of either the precipitate, or the 50 c. c. of alcoholic mixture, or of the wine itself, cannot be estimated to within less than 0·1 c. c. d. n. soda.

In Berthelot's method, however, the precipitate bitartrate is collected and its acidity directly estimated, and this can be done, as above stated, to within 0·1 c. c., whilst in Nessler's process the acidity of the precipitate is found from the difference in the acidity of the wine before and after the addition of alcohol; it is thus liable, even with the greatest care, to an error of 0·2 c. c.: if, for example, the acidity of the wine has been estimated 0·1 c. c. too high, whilst, after the addition of the alcohol, it has been estimated 0·1 c. c. too low.

Both Berthelot and Nessler have, in their estimation, used half the quantities of wine only which are here recommended; we have found that the accuracy obtainable by working with the quantities proposed by these authors is not sufficient, except in the case of wines tolerably rich in tartaric acid.

If the wine contains less bitartrate than corresponds to the solubility of this salt in the quantity of ether alcohol or alcohol employed, no tartaric acid at all will be found by these processes. This quantity is, however, only about 0·02 per cent. If it is, nevertheless, desired to estimate this small amount, or, if the presence or absence of any tartaric acid in a wine is to be demonstrated, the following plan may be adopted. A quantity of wine, say 100 c. c., is precipitated by a small excess of acetate of lead; the precipitate is collected, washed, suspended in water, and decomposed by a current of sulphuretted hydrogen. The excess of H_2S is then driven off by boiling, and the sulphide of lead removed by filtration. The clear solution thus obtained is evaporated to a small bulk, about one-quarter of its acid neutralized by potash, and a considerable excess of ether-alcohol mixed with it. After the lapse of forty-eight hours, the precipitate, if any be produced, may be examined as above described. Or, 100 c. c. of wine are precipitated by lime-water; the precipitate is washed and boiled with carbonate of potash. The carbonate of lime formed being removed by filtration, the alkaline filtrate is acidulated by acetic acid, and also mixed with a considerable excess of ether-alcohol or absolute alcohol. Any precipitate thereby produced must then be examined for tartaric acid.

In the majority of cases all the tartaric acid of the wine is present as bitartrate; that is to say, there is a sufficient amount of potash present to enable the whole of the tartaric acid to be precipitated in this form on the addition of ether-alcohol; the wines, in fact, frequently correspond to a solution of bitartrate, saturated at the lowest temperature to which the wine may have been exposed for a certain length of time.

As a general rule, all pure natural wine contains more or less of tartaric acid, and the quantity is probably the higher the riper the grapes from which it is produced. There is not, however, any apparent connection between the amount of tartaric acid present, and the quality of the wine. On the other hand, strongly fortified wines contain little or no tartaric acid, and this acid is almost entirely absent from all such wines during the production of which *plaster of Paris* has been employed.

In looking over the tables giving the results of our numerous wine-analyses the reader will see that in the great majority of cases, if not in all, the amount of tartaric acid corresponds to only a fraction of the total free fixed acid of the wine, the rest of which is, according to our researches, made up mostly of malic acid. Indeed, a very small error only will be committed if all the free fixed acidity not due to tartaric acid is put down to malic.

It must, however, be borne in mind that a part of the total amount of tartaric acid found is neutralized by potash, and is thus not included in the alkalimetric estimation of the total fixed acidity; and, on the other hand, that even the direct estimation of the bitartrate of the wine, by one of the above methods, does not give us the exact amount of that acid which in the wine contributes to the acidity. All wines contain more or less sulphate and chloride of potassium (found in the ash), and both salts are decomposed by tartaric acid under the above conditions, *i.e.* addition of ether-alcohol in which the bitartrate is insoluble. As long, however, as acids and bases are in solution, by far the greater portion of the alkali is in combination with the sulphuric and hydrochloric acid.

If, however, there is more alkali present than is capable of combining with the sulphuric and hydrochloric acid, it will be left in the ash as carbonate. The amount of tartaric acid, which can be neutralized by the amount of alkali found as carbonate in the ash being subtracted from the total amount of tartaric acid found, leaves the rest of the tartaric acid present in the wine as free fixed acid; and this, when subtracted from the total free fixed acid found, leaves the amount of malic acid present, expressed in its equivalent of tartaric acid. In this calculation, however, several acids, as succinic acid and part of the phosphoric acid, &c., present, are left out of consideration, and the amount of malic acid thus found can, therefore, be taken only as an approximation to reality.

Malic acid may, however, also be obtained in a somewhat more direct manner. A certain quantity of wine (say 50 c. c. or 100 c. c.) is precipitated with a slight excess of lime-water, the precipitate formed filtered off, washed, and the clear filtrate evaporated to about 25 c. c. or 50 c. c., to which is then added a considerable excess of absolute alcohol. The precipitate thereby produced consists chiefly of malate and sulphate of lime; it is collected on a weighed filter, washed, dried at 100°, and weighed. The sulphuric acid must then be estimated in a second quantity, and the amount of sulphate of lime thus shown to be present in the above precipitate being subtracted, the rest represents the malate of lime.

The other acids in the wine, with the exception of the mineral acids, of which we shall treat when describing the ash of wine, cannot at present be estimated with any degree of exactness.

CHAPTER VII.

THE ETHERS IN WINE.

Aceto-ethylic ether.—Aceto-propylic, butylic, amylic, caproylic, &c. ethers.—Butyro-ethylic, caprylo-ethylic, &c. ethers.—Œnantho-ethylic ether.—Tartaric ethers.—Berthelot's estimation of the ethers in wine.—New process for the determination of ethers in wine.—General principles.—General description of the process.—Determination of alcohol as acetic acid.—Determination of the fixed ethers.—Modification of the foregoing process.—Controlling experiments with wines.—Controlling experiments with tartaric ether.—Determination of the ethers in a variety of wines.—Results.—Consideration of Berthelot's theory of the limitation of ethers in wine.—Smell, bouquet, and aroma of wine.

ACETO-ETHYLIC ETHER.

If alcohol and acetic acid are mixed and left to stand, aceto-ethylic ether, commonly called acetic ether,—$C_2 H_3 (C_2 H_5) O_2$—is gradually formed; the process is very slow, and is never complete, owing to the simultaneous formation of water, the presence of which prevents complete etherification. The more diluted the acid and alcohol are, the smaller will be the proportion of acid ultimately converted into ether. The formation of the compound ether in this case is much facilitated by the addition of sulphuric acid. The ether may, however, be prepared much more readily by distilling ten parts of anhydrous acetate of soda, eight parts of alcohol of 90 per cent. and fourteen parts of sulphuric acid. The distillation is continued as long as the distillate is not completely miscible with a small quantity of water. The product at first obtained is washed with about its own bulk of water; the ether remaining on the top of the water is taken off, agitated with carbonate of soda, once more washed with water, and lastly dried over fused chloride of calcium. The dry ether is again distilled, once more dried over chloride of calcium, with which it now generally enters into a crystalline combination, easily decomposed, however, on application of heat. The ether distilled off from this compound is finally submitted to fractional distillation; those portions only which come over at a temperature of 74° C. are pure acetic ether.

Acetic ether is a colourless, transparent, very mobile liquid, possessing a very agreeable ethereal refreshing smell, and burning taste; it is neutral to test paper. It boils at a temperature of 74·3° C., but evaporates rapidly even at the ordinary temperature; its specific gravity is 0·9104, and it is miscible with alcohol and ether in every proportion. One part of ether requires about seven parts of water for its solution. On the other hand, the ether dissolves water, and the solution gradually becomes acid, owing to the decomposition of some of the ether into acetic acid and alcohol. When heated with an alkali, it readily breaks up into an acetate and alcohol, which reaction is used as a means of estimating the amount of compound ether present in a solution.

By far the greater part of the volatile ethers found in wine is acetic ether, and being volatile and possessing a very decided smell, it doubtless contributes much to the general flavour of the wine, although neither the characteristic wine flavour nor the peculiar bouquet of wines is due to it. In wine the ether is formed by the action of acetic acid on alcohol, perhaps facilitated by the presence of other acids, but kept within certain limits by the presence of water. As the formation of a compound ether under these conditions takes place gradually, the amount of it present at a given time is, to a certain extent, a measure of the age of the wine.

ACETO-PROPYLIC, BUTYLIC, AMYLIC, CAPROYLIC, ETC. ETHERS.

Just as acetic acid forms acetate of ethyl, or acetic ether, with ordinary (ethylic) alcohol, so it forms compound ethers with the alcohols of the above radicles. These ethers are formed and may be prepared by processes analogous to that given under acetic ether. They correspond in their general characters to acetic ether, and are all volatile, their boiling-point rising as the atomic weight of the alcohol from which they are formed increases. They have all an agreeable etherial smell, greatly resembling the smell of fruit, more particularly when much diluted; thus acetate of amyl has the smell of pears. All these ethers, when heated with an alkali, are decomposed into acetate and the relative alcohols.

As the alcohols corresponding to all the above-named radicles are found in wine, in minute quantity, some of the above ethers are undoubtedly present, particularly in old wine, and contribute to its flavour and bouquet.

BUTYRO-ETHYLIC, CAPRYLO-ETHYLIC, CAPRO-ETHYLIC, AND PELARGO-ETHYLIC ETHERS.

Just as acetic acid forms a series of ethers with the radicles of the alcohol series enumerated in the foregoing, so the other acids of the fatty acid series form each a series of ethers with the same series of alcohol radicles. In wine, we may expect these acids always to combine with the prevailing, namely ethylic, alcohol. The etherification is apparently facilitated by the presence of tartaric acid. Many of these ethers have a very powerful and characteristic odour. Very frequently this odour is rather disagreeable in the pure ether, but becomes agreeable, and resembles the aroma of fruit or flowers when greatly diluted. Thus butyric ether ($C_4 H_7 (C_2 H_5) O_2$) resembles the smell of pine-apples; caprylic ether ($C_8 H_{15} (C_2 H_5) O_2$) has much the same smell; caproic ether ($C_6 H_{11} (C_2 H_5) O_2$) has the smell of melons; and to pelargonic ether ($C_9 H_1 (C_2 H_5) O_2$) is probably due a portion of the characteristic wine-flavour.

ŒNANTHIC ETHER.

When large quantities of wine are distilled, a small amount of an oily liquid passes over towards the end of the distillation. Forty thousand parts of wine yield about one part of the oil. The same oil may also be obtained from wine yeast.

For this purpose the yeast is diluted with its own volume of water, and carefully distilled over an open fire. The first distillate is rectified when, towards the end of the rectification, the oil distils over. This oil is œnanthic ether mixed with a variable proportion of acid. To obtain the pure ether this crude oil is again distilled, and the first quarter coming over is collected separately. This is now shaken, and gently heated with a solution of sodium carbonate. The carbonate removes the free acid, but leaves the ether unaffected. In the cold the ether and carbonate form a sort of emulsion, from which the ether does not separate even after long standing. However, when the mixture is heated to boiling, the ether readily rises to the top. It is taken off and digested for some time over lumps of chloride of calcium, by which the last traces of moisture and of alcohol are removed.

The pure ether thus obtained is a colourless, thin, oily liquid, like oil of peppermint, with an overpowering vinous smell and a sharp, disagreeable taste. It has a specific gravity of 0·862, a vapour density of 10·508, and boils between 225—230° C. Its elementary composition is $C_{18}\ H_{36}\ O_3 = C_{14}\ H_{26}\ O''\ 2\ C_2\ H_5$. It is very soluble in ether, alcohol, or even very diluted spirit, but almost insoluble in water. The fixed caustic alkalies readily decompose it into alcohol and œnanthic acid; the alkaline carbonates, and aqueous ammonia are, however, without action on it.

The characteristic vinous smell which distinguishes all kinds of wine from every other fermented liquid, is due to the presence of this œnanthic ether. The flavour or bouquet, however, by which the wines of different vineyards and vines are distinguishable from each other, is produced by substances of different nature and composition.

TARTARIC ETHER.

As a dibasic acid, tartaric acid is capable of forming two varieties of ethers, namely neutral and acid ones. Only the latter kind is met with in wine, or formed by the mere digestion of tartaric acid with alcohol. Tartro-ethylic ether—$C_4\ H_5\ (C_2\ H_5)\ O_6$—is a solid, crystallizable, but deliquescent body, which behaves like an acid, inasmuch as it can combine with an atom of base, and form neutral salts. Its calcium, lead, and silversalt are rather insoluble in an excess of the acid ether. It cannot be distilled without breaking up into various products.

By the influence upon each other of the alcohols and acids shown to be present in wine, a considerable number of compound ethers may be produced. For, supposing five acids and five alcohols to be present, they might produce twenty-five compound ethers, some or all of which might be present and contribute their share to the flavour, such flavour altering as one or the other ether predominated. All these ethers occur in wine in extremely minute quantity only, and almost entirely elude ordinary analysis. However, in the manufacture of brandy enormous quantities of wine are distilled and a considerable amount of so-called fousel oil obtained, in which a number of the above-named volatile acids and ethers, as well as several different alcohols, have been detected. In order to completely study the subject, it would be necessary not only to collect these fousel oils, which generally constitute the part distilling over last, but to submit the brandy itself to oft-repeated fractional distillation, so as to obtain the more volatile ethers as well.

fusel oil

BERTHELOT'S ESTIMATION OF THE ETHERS IN WINE.

Berthelot endeavoured to estimate the amount of compound ethers in wine by means of a process of volumetrical analysis. He estimated the free acid of the wine by a standard solution of baryta, and heated a second portion of the same wine for some time with a known excess of the same baryta water. During the heating, the compound ethers were decomposed into alcohol and acid, which latter neutralized a part of the baryta. After the heating, the amount of baryta left uncombined was determined, whereby the amount which had become neutralized during the boiling was ascertained. The acid so combined had existed as compound ether in the wine.

This process is no doubt very accurate when applied to pure compound ethers or their dilute watery or alcoholic solutions, but when it is applied to wine it loses that accuracy, because this fluid nearly always contains matters which, by heating with alkali, yield acid and neutralize alkali, and yet have not the properties of ethers. The presence of sugar makes the process totally inapplicable. We have therefore found ourselves under the necessity of devising the following new process for the determination of ethers in wine.

NEW PROCESS FOR THE DETERMINATION OF ETHERS IN WINE.

General Principles of the Process.

It is based upon the fact that there are two classes of compound ethers present in wine, one class being volatile, and having for its type acetic ether; the other being fixed, and having tartaric ether as its type. If a wine is carefully distilled, the volatile ether will pass over into the distillate, while the fixed ether will remain with the matter in the retort.

The ether in the distillate may be estimated as follows:—The distillate is put into a flask and a quantity of decinormal soda solution added. The flask is closed by a caoutchouc stopper, and then heated for some time, not under one hour and not exceeding six hours. After that time the amount of alkali which has been neutralized is ascertained.

The ether in the residue is decomposed by boiling with an alkali; the alcohol set at liberty is distilled over and estimated.

Thus the amount of volatile ether is calculated from the equivalent of acid which it yields by decomposition, while the amount of fixed ether is calculated from the equivalent of alcohol which it yields by decomposition.

General Description of the Process.

250 c. c. of wine are introduced into a flask, and about 200 c. c. are distilled over; the bulk of the distillate is raised to 250 c. c. by means of water; in 100 c. c. of this the free acid is determined by a standard decinormal soda solution. In a second hundred c. c. the ether is estimated by decompo-

sition with alkali, and determination of the amount of acid formed.

Half a litre of the same wine is next evaporated on the water-bath to 50 or 60 c. c. (As the last traces of alcohol are not easily removed from wine by heating *in a retort or flask* without danger of some slight decomposition being incurred, we prefer to estimate the fixed ethers in a residue obtained by evaporation *in an open dish*, and not in the residue remaining from the distillation of the volatile ethers.) This residue is put into a flask, rendered alkaline by sodium hydrate, the flask connected with a condenser and slowly heated to decompose all the ether; ultimately, about three-quarters of its bulk are distilled over. This first distillate, which is generally strongly alkaline from ammonia, is rendered slightly acid by sulphuric acid, and again distilled, 25 c. c. being now driven over. These now contain all the alcohol which had been present as fixed ether in the half-litre of wine. This quantity may be determined either by estimating the specific gravity of the distillate or by oxydizing the alcohol into acetic acid, in the manner to be described immediately. Howsoever determined, if the amount of alcohol found is divided by 20, we get the percentage of alcohol present as fixed ether in the original wine.[1]

In all our analyses the distillation of alcoholic as well as acetic acid fluids was performed from a specially contrived flask. An extra tube was blown to the side of the neck for connection with the condenser. The main

[1] The alcohol thus obtained is of course only a very small quantity, and even when all concentrated into the 25 c. c. makes very weak spirit. To show that no appreciable quantity of other substances influencing the specific gravity is present, it is only necessary to estimate the alcohol in such a sample by specific gravity, and by Geisler's instrument, when it will be found that both yield identical results. The latter instrument has been found very convenient for estimating the strength of such weak solutions. It should be carefully graduated for them, and its zero-point, or point to which the mercury rises in the pressure tube when water only is in the flask, should be determined for each experiment, as of course it varies with the barometer. If a modification of Geisler's instrument could be devised in which the pressure exerted by the vapour were measured by a column of water instead of mercury, it might be a very valuable means for the estimation of very small quantities of alcohol.

aperture was used for introducing the fluids, so as not to permit them to touch the lateral tube, and closed. The lateral tube was then connected air-tight with the condenser, and this latter air-tight with the receiver. To the latter a valve of glass-tubing, with a little mercury in it, was attached. The air in the apparatus was thus enabled to expand and contract, and yet during the progress of the distillation all evaporation and consequent loss was avoided. We were thus enabled to distil very dilute spirits, containing perhaps less than half a grain of alcohol in 20 oz. of water, four or five times without loss of alcohol.

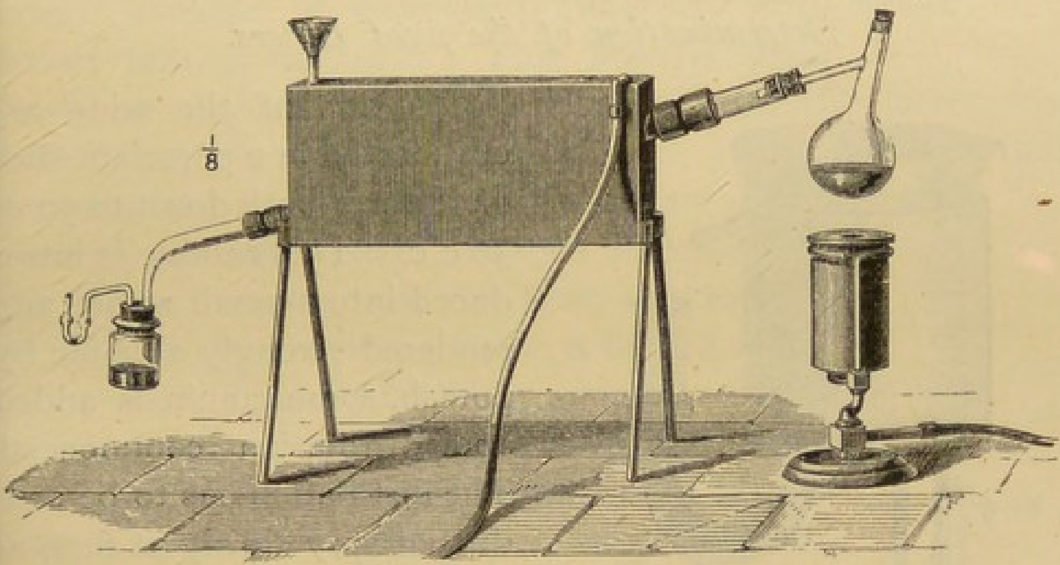


FIG. 32.—Apparatus employed for the decomposition of the fixed ethers of wine, and for the distillation of acetic acid in the estimation of fixed ethers.

Determination of Alcohol as Acetic Acid.

In our endeavours to apply the method to a variety of wines, we met with a difficulty arising from the small amount of alcohol obtainable from the ethers in some of them. We therefore, instead of determining such alcohol directly, oxydized it to acetic acid, and determined the quantity of this product volumetrically. How accurately small quantities of alcohol can be thus determined, the following experiments show :—

(1) 0·1 grm. alcohol in 20 c. c. distilled water, when oxydized by bichromate and sulphuric acid, yielded by distillation

acetic acid, which neutralized 20·1 c. c. d. n. soda, equivalent to 0·0924 grm. alcohol.

(2) 0·025 grm. alcohol gave acetic acid, which neutralized 5·5 c. c. d. n. soda, equivalent to 0·0253 grm. alcohol.

The method[1] of determining minute quantities of alcohol after oxydation as acetic acid has, in its application to wine, this particular advantage, that it can be performed upon smaller quantities of wine than would be requisite for determining the alcohol by the specific gravity method. The process is, at the same time, quite equal, if not superior, in accuracy to the estimation of the volatile ethers by titration.

Determination of the fixed Ethers.

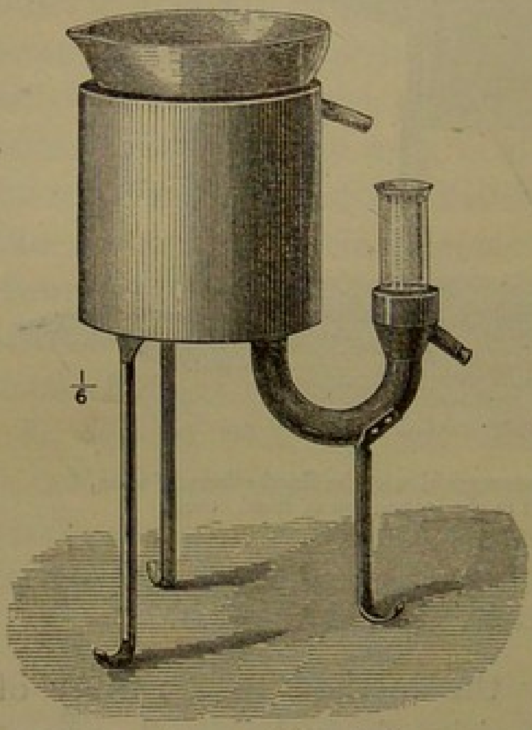


FIG. 33.—Water-bath.

250 c. c. of the wine are evaporated in a porcelain dish on a water-bath down to 50 or 30 c. c. This residue is introduced into a small retort and rendered strongly alkaline by potash, some tannin is added and distillation commenced. The distillation has to be conducted very slowly at first, as the mixture froths and can hardly be prevented from rising into the condenser. But, even if this accident should occur, it need not destroy the analysis, provided the mixture has previously been heated sufficiently to destroy all compound ethers. When about three-quarters of the contents of the retort have

[1] We have used this analytical process for estimating the small quantities of alcohol which are secreted by the kidneys, after the ingestion into the stomach of moderate doses of alcoholic liquids. The entire secretion of twenty-four hours was repeatedly distilled, being alternately rendered acid and alkaline. The fourth or fifth distillate, amounting to about 20 c. c., was then treated as above.

passed over, the distillation is arrested, the distillate rendered slightly acid by sulphuric acid, and again distilled. This time the distillation is effected without any trouble, and about half the fluid, amounting to not less than 20 c. c., is distilled over. These 20 c. c., containing all the alcohol of the fixed ethers originally present in the 250 c. c. of wine, are put into a small, strong flask (small assay flask), mixed with 10 c. c. of a solution of bichromate of potassium (containing 147 grms. bichromate and 220 grms. sulphuric acid made up to 1400 c. c. solution by water), capable of oxydizing about 0·2 grm. alcohol into acetic acid. The flask is then closed by a good caoutchouc stopper, and the latter tied down by a piece of canvas and string. The flask is then suspended upright in a water-bath—care being taken to prevent contact between solution and caoutchouc stopper, and to keep the neck of the flask above the water—and is heated for an hour or two. The flask is then removed, cooled, opened, and some zinc and sulphuric acid added, whereby in a short time all the excess of bichromate is reduced. The green solution is then transferred to a small retort, some more sulphuric acid and some pieces of broken tobacco pipe stem are added, and distillation effected over an Argand gas-burner or from an oil-bath, care being taken to prevent spirting. When the liquid is distilled nearly to dryness, the distillation is stopped for a moment, some water added to the contents of the retort, and the distillation proceeded with until the residue has again reached a point of high concentration. Water is again added and distillation renewed, and ultimately a third portion of water is added and driven over. The united distillates contain all the acetic acid formed.

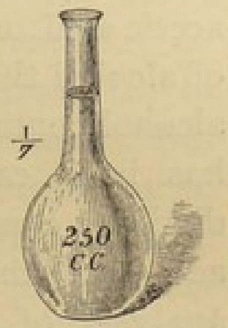


Fig. 34.—Measuring Flask, holding the quantity marked on the body of the flask when filled up to the circular mark round the neck.

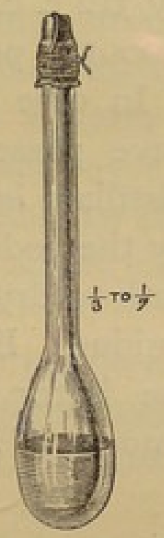


Fig. 35.—Assay Flask, used for decomposing the volatile ethers by heating with an alkali, and for oxydizing the alcohol of the fixed ethers by the chromate solution. The flask used for the former process is seven times, that used for the latter three times, the size of the engraving.

The acidity in them is estimated by decinormal soda solution, each cubic centimetre of which neutralizes 0·006 grm. acetic acid, or is equivalent to 0·0046 grm. alcohol. The amount of alcohol thus formed, divided by 2·5, gives the percentage of alcohol contained as fixed ethers in the wine. If the process has been carefully conducted, it will be found that the distillate containing the acetic acid is quite free from sulphuric acid, and that, therefore, the determination by volumetrical analysis of the amount of its acidity affords a correct measure of the acetic acid contained in it. As this amount can easily be estimated to within 0·2 c. c. of the above soda solution, and with care to within 0·1 c. c., and as these quantities are equivalent to 0·0012 and 0·0006 grm. of acetic acid, or to 0·00092 and 0·00046 grm. of alcohol respectively, an accuracy is ensured which suffices for all purposes. The two quantities of alcohol just given, which are indicated by 0·2 c. c. and 0·1 c. c. of soda, are equal to 0·000368 and 0·000184 per cent. of alcohol in the wine taken.

In case some of the sulphuric acid in the retort should have passed into the distillate by spirting, we divide the distillate into two accurate halves, estimate the acidity of one by the soda solution, evaporate the other half on the water-bath to dryness, and determine the acidity in its re-dissolved residue. By the deduction of the amount of acid found in the latter from that found in the former, we obtain the amount of acetic acid contained in half the distillate.

Modification of the foregoing Process.

The amount of alkali necessary to neutralize the whole of the impure distillate is carefully ascertained. A corresponding amount of standard sulphuric acid is now added, and the whole evaporated to dryness on the water-bath. The residue is taken up with water and its acidity again determined. The latter, subtracted from that first found, gives the acetic acid. This proceeding is also good to make sure whether or not sulphuric acid has passed into the distillate; for if one-half be evaporated, the acidity of the residue will be *nil*. Or if the whole be neutralized by soda, and then again acidified by the amount of acid equivalent to the soda used and evaporated, all the acetic acid will be driven off and a neutral residue will remain.

If an amount of alcohol should be found equal to, or approaching the total amount which the bichromate employed is capable of oxydizing, a second estimation has to be made with more of the bichromate or less of the alcoholic solution. With a little practice it is easy to judge from the colour of the contents of the flask very closely of the amount of reduced bichromate; and if this should approach the total quantity present, the experiment should at once be repeated.

Controlling Experiments with Wines.

We have found by many experiments that wine may be distilled from a retort on a water-bath, or even on a sand-bath, without any of the ethers undergoing decomposition. Let the acidity of a wine be carefully determined, then distil a measured quantity of this wine from a retort on a water-bath, until from one-half to four-fifths have passed over. Then unite distillate and residue, determine the acidity of the mixture, and it will be found identical with the acidity of the original wine.

Rauenthaler, 1862, at 54*s.* per dozen. 50 c. c. wine required 38·0 c. c. d. n. soda. 300 c. c. wine distilled, three-quarters driven over, distillate added to residue; 50 c. c. of this required 37·8 c. c. d. n. soda.

Rauenthaler, 1864, 18*s.* per dozen. 50 c. c. wine required 55·5 c. c. d. n. soda. 50 c. c. wine distilled in water-bath, distillate added to residue; product required 55·3 c. c. d. n. soda.

Hattenheimer, 1862, 36*s.* per dozen. 50 c. c. required 40 c. c. d. n. soda. 50 c. c. distilled over Argand burner, more than half driven over, and re-added to residue, required 39·9 c. c. d. n. soda.

Sherry, about fifty years in bottle. 50 c. c. wine required 42·7 c. c. d. n. soda. 50 c. c. distilled nearly to dryness in sand-bath, water added to residue and again distilled; lastly, distillate added to residue, required 42·0 c. c. d. n. soda.

Madeira, 1815, bottled 1817. 50 c. c. of the wine required 39·7 c. c. d. n. soda. 50 c. c. wine evaporated almost to dryness in saltwater bath, distillate added to residue, required 38·7 c. c. d. n. soda.

The operation may be conducted over a sand-bath, or even a free low Argand gas-burner, without any deviation of the result. If any compound ether were decomposed, the acidity would be increased. If the heating of the retort is carelessly conducted, the acidity is certainly altered, but not in the sense in which a decomposition of ethers would alter it. Instead of increasing, it falls; and if the heating is continued long enough, the acidity of the residue is almost destroyed, although no acid passes into the distillate. The dry residue of a wine, when heated for several days on the water-bath, has lost nearly all its acidity.

Controlling Experiments with Tartaric Ether.

1. In half a litre of dilute spirit (13 per cent. by weight of alcohol) 20 grammes of sugar were dissolved, and the mixture evaporated on the water-bath to 60 c. c. These were treated for volatile ether as above, and yielded 25 c. c. of distillate, having at 15·5° C. a specific gravity of 999·99.

2. Two mixtures of alcohol, tartaric ether, and tartaric acid, were prepared by boiling pure tartaric acid for some hours with pure absolute alcohol. The mixture was then diluted with water and alcohol, so as to bring its alcoholic strength to 10 per cent. and its acidity to about that of wine. The alcohol present in the mixture, in combination with tartaric acid, was then estimated by titration and by our new method, with the following result.

(*a*.) 50 c. c. required 36·5 c. c. decinormal soda. 50 c. c. mixture, when heated in flask with 60 c. c. decinormal soda, left 14·8 c. c. soda unneutralized; and as 36·5 c. c. were neutralized before the heating, 8·7 c. c. soda must have been neutralized during the boiling, corresponding to 0·08004 per cent. alcohol present in the mixture as tartaric ether.

Half a litre of the same mixture was next evaporated on a water-bath to 60 c. c. These were made strongly alkaline and distilled; the first distillate was rendered acid and again distilled, 28·5 c. c. being obtained. Those at 15·5 had a specific gravity of 997·50, showing 1·34 per cent. alcohol, which, calculated for the half-litre taken, give 0·0760 per cent. alcohol present in the mixture as tartaric ether.

(*b*) 50 c. c. of another mixture required 24·5 c. c. d. n. soda. 50 c. c. mixture, heated in flask with 50 c. c. d. n. soda, left 29·6 c. c. unneutralized, and as 24·5 c. c. soda were neutralized before the heating, 5·9 c. c. were neutralized during heating, corresponding to 0·05428 per cent. alcohol present in the mixture as tartaric ether. Half a litre of the same mixture, with 20 grms. of cane sugar evaporated to 60 c. c. on a water-bath, and the residue, heated as above, gave 28·5 c. c. of distillate, having at 15·5° C. a specific gravity of 998·30, showing 0·91 per cent. alcohol, which, calculated for the half-litre taken, gives 0·0520 per cent. alcohol present in the mixture as tartaric ether.

We have therefore—

	Alcohol estimated	
	By titration.	By our plan.
Experiment 1 . .	0·08002 . .	0·0760
,, 2 . . .	0·05428 . .	0·0520

The fact that this acid tartaric ether is not decomposed by evaporation on a water-bath is also shown by the following experiment.

3. Another mixture of tartaric acid and tartaric ether was diluted with alcohol of 10 per cent., so that 20 c. c. of the mixture required 28·2 c. c. decinormal soda for neutralization; by titration, as above, it was found that an amount of acid equivalent to 10·1 c. c. d. n. soda was neutralized through the ether present in the 20 c. c.

Of this mixture, four quantities of 20 c. c. each were placed in small evaporating dishes and heated on a water-bath. The first was evaporated to $\frac{1}{4}$, the second to $\frac{1}{10}$, the third to dryness, and the fourth was heated for one hour after it had become dry.

Original mixture required .	28·2 c. c. d. n. soda.	
The 20 c. c in 1st dish .	28·2 ,,	,,
,, ,, 2nd dish .	28·4 ,,	,,
,, ,, 3rd dish .	28·4 ,,	,,
,, ,, 4th dish .	28· ,,	,,

If any appreciable decomposition had taken place, the amount of free acid would have varied instead of remaining as it did on its original height.

Determination of the Ethers in a variety of Wines.

Rauenthaler, 1864, at 18*s*. per dozen. Alcohol, 7·44 per cent. by weight; free fixed acid, as $\overline{T}$, 0·674; free volatile acid as $\overline{A}$, 0·118; alcohol equivalent to total free acid, per litre, 5·0485 grammes; dry residue = 2·207. Sugar traces right-handed. 1 litre distilled in saltwater bath, 100 c. c. remained; these were made strongly alkaline and distilled; distillate amounted to 60 c. c. Specific gravity at 15·5 = 999·14 = 0·45 per cent. by weight, or 0·027 per cent. in original wine.

300 c. c. distilled, two-thirds distilled over; residue treated as above, but distillate rendered acid and again distilled; 25 c. c. obtained. Specific gravity at 15·5 = 999·45 = 0·29 per cent. = 0·024 per cent. of original wine.

250 c. c. evaporated on water-bath to 50 c. c.; residue boiled as above in second case; $\overline{A}$ obtained neutralized 14·2 c. c. d. n. soda, equivalent to 0·0653 grm. alcohol, or 0·0261 per cent.

100 c. c. evaporated to 25 c. c. $\overline{A}$ obtained neutralized 6·0 c. c. d. n. soda = 0·036 grm. $\overline{A}$, equivalent to 0·0276 per cent. alcohol.

250 c. c. evaporated to 25 c. c. $\overline{A}$ obtained neutralized 12·6 c. c. d. n. soda = 0·05796 grm. alcohol, or 0·0232 per cent.

SUMMARY.

					Per cent. of Wine.
By specific gravity from	1 litre	evaporated	in flask	to 1-5th	0·0270
,, ,,	300 c. c.	,,	,,	1-3rd	0·0240
By oxydation from	250 c. c.	,,	on water-bath	to 1-5th	0·0261
,, ,,	100 c. c.	,,	,,	1-4th	0·0276
,, ,,	250 c. c.	,,	,,	1-10th	0·0232
Alcohol in fixed ethers, mean					0·0256
Add alcohol in volatile ethers by titration					0·0175
Total alcohol in ethers found					0·0431
,, ,, calculated					0·0581

Hattenheimer, 1862. Alcohol, 9·97; free fixed acid as $\overline{T}$, 0·525; free volatile acid as $\overline{A}$, 0·067; dry residue, 2·235;

alcohol equivalent to total free acid, per litre 3·6 grm. ; sugar, 0·017 per cent.

Fixed ethers : (*a*) *By distillation and specific gravity.* 300 c.c. wine taken, two-thirds distilled, residue, &c. treated as above. 25 c. c. distillate. Specific gravity at 15·5 = 999·58 = 0·220 per cent. = 0·0183 in original wine. (Geisler's instrument gave strength of distillate = 0·25 per cent.)

(*b*) *By oxydation.*—250 c. c. evaporated on water-bath to 40 c. c. $\overline{\text{A}}$ obtained neutralized 11·4 c. c. d. n. soda = 0·05244 grm. alcohol, or 0·0209 per cent.

250 c. c. evaporated to 30 c. c. $\overline{\text{A}}$ obtained neutralized 11·2 c. c. d. n. soda = 0·05152 grm. alcohol, or 0·0206 per cent.

SUMMARY.					Per cent. of Wine.
By specific gravity	from	300 c. c.	evaporated in flask to 1-3rd		0·0183
By vaporimeter	,,	300 c. c.	,,	,,	0·0208
By oxydation	,,	250 c. c.	,,	on water-bath to 1-6th	0·0209
,,	,,	250 c. c.	,,	,, 1-8th	0·0206
Alcohol in fixed ethers, mean					0·0201
Add alcohol in volatile ethers by titration					0·0253
Total alcohol in ethers found					0·0454
,, ,, calculated					0·0521

Rauenthaler, 1862, 54*s*. per dozen ; alcohol, 8·83 per cent., by weight. Free fixed acid, as $\overline{\text{T}}$ 0·445 ; free volatile acid, as $\overline{\text{A}}$ 0·178. Alcohol equivalent to total free acid per litre 3·5075 grms. Dry residue, 1·867. Sugar, 0·062 per cent.

Fixed ethers : (*a*) *By vaporimeter.* Half-litre evaporated to one-fourth in water-bath, residue made strongly alkaline and distilled, distillate rendered acid, and again distilled, 25 c. c. passed over. Strength of distillate, estimated by Geisler's instrument, 0·45 per cent. by weight, giving 0·0225 per cent. of alcohol present in wine as fixed ether.

(*b*) *By conversion into* $\overline{\text{A}}$: 300 c. c. wine evaporated on water-bath to 20 c. c. ; residue treated as above. $\overline{\text{A}}$ obtained neutralized 14·5 c. c. d. n. soda, equivalent to 0·0667 grm. alcohol, or 0·0222 per cent. of the wine.

250 c. c. wine evaporated on water-bath to 50 c. c. ; residue treated as usual. $\overline{\text{A}}$ obtained neutralized 11·3 c. c. d. n. soda, equivalent to 0·05198 grm. alcohol, or 0·0208 per cent. of the wine.

SUMMARY.	Per cent. of Wine.
By vaporimeter from ½ litre evaporated on bath to ¼	0·0225
By oxydation, from 250 c. c. ,, ,, ⅕	0·0208
,, ,, 300 c. c. ,, ,, $\frac{1}{15}$	0·0222
Alcohol in fixed ethers, mean	0·0218
Add alcohol in volatile ethers by titration	0·01656
Total alcohol in ethers found	0·0383
,, ,, calculated	0·0460

Steinberger Cabinet, 1858, at 120*s*. per dozen; alcohol 9·74 per cent. by weight. Free fixed acid, as $\overline{T}$ 0·411 per cent. free volatile acid, as $\overline{A}$, 0·131 per cent.; total dry residue, 2·073 per cent. Alcohol equivalent to total free acid per litre 3·52 grms. Sugar none.

300 c. c. wine evaporated on water-bath to 20 c. c.; residue treated as usual; $\overline{A}$ obtained neutralized 14·5 c. c. d. n. soda, equivalent to 0·0667 grm. alcohol, or 0·0222 per cent. of wine. 250 c. c. wine evaporated on water-bath to 50 c. c.; residue treated as usual; $\overline{A}$ obtained, neutralized, 13·4 c. c. d. n. soda, equivalent to 0·06164 grm. alcohol, or 0·0246 per cent. of wine.

SUMMARY.	Per cent. of Wine.
By oxydation from 250 c. c. evaporated on bath to ⅕	0·0246
,, ,, 300 c. c. ,, ,, $\frac{1}{15}$	0·0222
Alcohol in fixed ethers, mean	0·0234
Add alcohol in volatile ethers by titration	0·02944
Total alcohol in ethers found	0·0528
,, ,, calculated	0·0499

Light Claret, at 15*s*. per dozen; alcohol, 9·05.

Free fixed acid as $\overline{T}$ . . .	0·338	Alcohol equivalent to total free acid calculated as $\overline{A}$, per litre = 3·777 grms.
Free volatile acid as $\overline{A}$.	0·222	
Residue	2·167	Sugar . . . . 0·047 per cent.

250 c. c. evaporated to 40 c. c. $\overline{A}$ obtained neutralized 8·3 c. c. d. n. soda = 0·03818 grm. alcohol, or 0·0152 per cent. 250 c. c. evaporated to 15 c. c. $\overline{A}$ obtained neutralized 7·4 c. c. d. n. soda = 0·03404 grm. alcohol, or 0·0136 per cent.

SUMMARY.	Per cent. of Wine.
By oxydation from 250 c. c. evaporated on water-bath to ⅙ . . .	0·0152
,, ,, 250 c. c. ,, ,, $\frac{1}{16}$ . . .	0·0136

	Per cent. of Wine.
Alcohol in fixed ethers, mean	0·0144
Add alcohol in volatile ethers by titration	0·0170
Total alcohol in ethers found	0·0314
,, ,, calculated	0·05056

Madeira. Alcohol 24·1 per cent. by weight.

Free fixed acid as $\overline{\mathrm{T}}$. 0·2244 } Alcohol equivalent to total free acid, per
Free volatile acid as $\overline{\mathrm{A}}$. 0·1470 } litre = 2·69 grms.
Residue . . 6·18 per cent. | Sugar . . 1·40 per cent.

250 c. c. wine evaporated by 40 c. c. $\overline{\mathrm{A}}$ obtained neutralized 15·9 c. c. d. n. soda = 0·07314 grm. alcohol, or 0·0292 per cent. 250 c. c. evaporated to 25 c. c. $\overline{\mathrm{A}}$ obtained neutralized 15·9 c. c. d. n. soda = 0·07314 grm. alcohol or 0·0292 per cent.

SUMMARY.	Per cent. of Wine.
By oxydation from 250 c. c. evaporated on bath to $\frac{1}{8}$ . . .	0·0292
,, ,, 250 c. c. ,, ,, $\frac{1}{10}$ . . .	0·0292
Alcohol in fixed ethers, mean	0·0292
Add alcohol in volatile ethers by titration	0·03348
Total alcohol in ethers found	0·0627
,, ,, calculated	0·0834

Forster Traminer Auslese, 1862, at 24*l.* per ohm; alcohol 10·81 per cent.; free fixed acid as $\overline{\mathrm{T}}$ 0·2244; free volatile acid as $\overline{\mathrm{A}}$ 0·1290; alcohol equivalent to total free acid per litre, 2·55 grms. Dry residue, 2·30. Sugar less than 0·02 per cent.

250 c. c. wine evaporated to 40 c. c. $\overline{\mathrm{A}}$ obtained; neutralized 6 c. c. soda, equivalent to—

SUMMARY.	Per cent. of Wine.
Alcohol in fixed ethers	0·0110
Add alcohol in volatile ethers by titration	0·0221
Total alcohol in ethers found	0·0331
,, ,, calculated	0·0394

Oestricher, 1862, at 36*l.* per ohm.; alcohol 11·02 per cent.; free fixed acid as $\overline{\mathrm{T}}$ 0·3829; free volatile acid as $\overline{\mathrm{A}}$ 0·1230; alcohol equivalent to total free acid per litre 3·542 grms. Dry residue, 2·375. Sugar trace. 250 c. c. wine evaporated to 40 c. c.; $\overline{\mathrm{A}}$ obtained neutralized 11·4 c. c. soda equivalent to—

	Per cent. of Wine.
Alcohol in fixed ethers	0·0209
Add alcohol in volatile ethers by titration	0·0354
Total alcohol in ethers found	0·0563
,, ,, calculated	0·0556

Results.

Wines when carefully distilled do not experience any change in the amount of their free acid. Our method of determining the quantity of ether in wine gives constant results; all the free alcohol or volatile ether of wine is expelled by a concentration of the wine to one-fifth ; no tartaric, nor any similar ether, is decomposed even when the wine is reduced to one-sixteenth of its original bulk; the process of analysis is as applicable to light weak wines free from sugar as to strong heavy wines with a considerable amount of sugar.

CONSIDERATION OF BERTHELOT'S THEORY OF THE LIMITATION OF ETHERS IN WINE.

According to Berthelot, the amount of ethers found in any mixture of alcohols and acids is after a certain time a constant quantity, independent of the nature of the alcohols and acids present, but a function only of their relative amount.

He gives the following formula for calculating the amount of alcohol contained in the compound ether of one litre of a mixture of acids, alcohols and water, such as wine essentially is, when etherification is complete. Let A be the percentage by weight of alcohol in the mixture. In all our calculations with regard to wine for A was taken the alcoholic strength (in per cent. by weight) of the distillate, both wine and distillate being measured; a be the amount of alcohol equivalent to the total free acid contained in one litre wine, on the assumption of its being acetic acid (46 alcohol equivalent to 60 acetic acid), y the proportion per cent. of a present as compound ether in one litre wine, when the alcoholic strength of the wine is A ; and lastly x be the amount of alcohol present in the compound ethers of one litre wine. Then

$$y = 1{\cdot}17\,A + 2{\cdot}8$$

$$x = \frac{y \times a}{100}.$$

The formula holds good up to an alcoholic strength of 25 per cent. As in all wines by far the greatest proportion of the alcohols present is ethylic alcohol, the error made in leaving the other alcohols out of consideration is insignificant.

Thus in the Hattenheimer analysed above,

$$A = 9{\cdot}97,$$
$$\text{and therefore } y = 1{\cdot}17\,A + 2{\cdot}8 = 14{\cdot}4649.$$

The amount of free acid per litre calculated as acetic acid is 4·7 grms., and therefore equivalent to 3·6 grms. alcohol. If 14·4649 per cent. of this is present as ether, we have $\frac{14{\cdot}4649 \times 3{\cdot}6}{100} = 0{\cdot}5207$ grm. calculated amount of alcohol per litre present in ether, while the quantity actually found amounted to 0·4540 grm.

In all the examples illustrating our new method, the amount of alcohol that should be present as ether has been calculated, according to the above formula, and in general the correspondence with actual analysis is very satisfactory. The only exceptions to this rule are the light claret and Madeira. The first is probably a very young wine, in which etherification is not yet complete; the second has probably had a large quantity of alcohol added to it not very long before our analysis, and has on that account not yet arrived at the state of equilibrium.

Assuming the correctness of Berthelot's formula, we obtain thus, by the estimation of ether, a valuable means of judging of the age and genuineness of wines. Thus a natural wine should during the first few years contain somewhat less ether than required by the formula; the amount should gradually augment with age, until after from four to six years the maximum would be reached. If then an appreciable amount of alcohol be added, the wine be fortified, etherification will begin afresh, and again reach a maximum after a number of years. On the other hand, a wine prepared artificially, with addition of ethers, will probably at once show a maximum of ethers, or will even exceed this, and will then, instead of increasing in richness, remain stationary, or show a diminution of the ether with increasing age.

In looking on the amounts of alcohol present as ether in the wines above described, we observe that although the total amount generally agrees closely with that required by theory, yet the amount present in fixed and volatile ether bears no regular relation to the amount of fixed and volatile acids present. The amount of alcohol present as volatile ether is almost always greater than the amount present in fixed ether, in spite of the circumstance that the amount of volatile acid present is almost always much smaller than the amount of fixed acid. The proportion between the volatile and fixed ethers bears no relation to the amounts of volatile and fixed acids present. All the fixed acids are present already in the grape-juice, and their etherification can therefore begin as soon as alcohol begins to be formed during fermentation and continue simultaneously with its production. Moreover, the amount of fixed acids is greatest at the beginning of the fermentation, decreasing as the amount of alcohol increases, on account of the lesser solubility of acid tartrate of potassium in alcoholic liquids. We are therefore justified in concluding that the amount of fixed ethers formed in a given time is greatest in quite young or even still fermenting wine.

The volatile acids, on the other hand, are all formed during or after fermentation. If therefore fermentation has taken place under circumstances unfavourable to the production of volatile acids (acetic acid), as at a low temperature, or in closed casks, little or no volatile acid will be present at first, but the amount will increase gradually with the age of the wine, provided it is kept in casks. In such a wine therefore the production of fixed ethers begins before that of the volatile ethers. But the continually increasing amount of volatile acids, aided by their greater tendency to etherification and the gradual decrease in the amount of fixed acid, soon reverses the conditions, and causes the volatile ethers to preponderate.

In judging of the relative quantity of free fixed and volatile acids present, it should, however, be borne in mind that the volatile ethers being neutral ethers neutralize their acid completely, whilst the fixed ethers being acid ethers have only half their acid neutralized. It is therefore necessary, in order to determine that part of fixed acid which is really free and uncombined, to subtract an amount of acid equal to that found neutralized in the fixed ethers from the total amount of free fixed acid found. And from this the acid present as bitartrate should perhaps also be deducted in order to obtain data by which the amount of etherification due to fixed and volatile acids respectively may be accurately determined.

SMELL, BOUQUET, AROMA, ETC. OF WINE.

The odoriferous constituents of wine may be conveniently divided into two classes: firstly, such as are more or less common to all wines, forming what is termed the vinous smell; and secondly, such as are characteristic of particular kinds of wine.

The first of these we have already considered, when speaking of the acids of wine; they consist essentially of certain compound ethers formed in the wine by the action of its acids on its alcohols.

The second class of odoriferous constituents may again be subdivided into two kinds: first, such as are already present in the grape, and are unaltered during fermentation, *e.g.* the smell of the muscatel and Isabella grape; and secondly, such as are formed during and after fermentation, partly out of substances already present in the grape, partly from matters formed during or after fermentation. The first class are found in what are termed aromatic wines, the second in bouqueted wines. The substances characterizing aromatic wines are formed apparently in greater quantity with the increasing ripeness of the grape, and belong probably to the category of essential oils. On the other hand, the substances yielding the bouquet are sometimes contained in greater quantity in unripe than in the ripe grape. Their chemical nature is but little understood. Partly, no doubt, they consist of a mixture of compound ethers, formed by the middle members of the fatty acid series. These acids originate in the oxydation of albuminous substances, as well as in the oxydation of some of the higher members of the series, or their fats. Both these substances are found in wine, and gradually disappear whilst the bouquet is gradually produced, and it seems therefore probable, that at least some part of them is oxydized into these acids. The more important constituents of the true bouquet, however, seem to be of a different nature. The fruit, blossoms, or other parts of certain plants, when submitted to fermentation, produce a small quantity of essential oil, termed ferment oil, which possesses a characteristic smell, not unfrequently resembling the bouquet of certain kinds of wine. Thus, the flowers of elder, when allowed to ferment with the must, impart to it the aroma of muscatel grapes; whilst the flowers of the vine itself under these circumstances produce the Rhine-wine bouquet.

Berthelot has endeavoured to separate the odoriferous constituents of the wine by means of ether, but owing to the small quantity of these substances present, and on account of their extremely unstable characters when exposed to heat or the action of oxygen (or air), he did not obtain any definite results. Wine (several litres should be taken) is very carefully neutralized and then shaken up with ether. The ether is syphoned off and evaporated at a low temperature, air being at the same time perfectly excluded. The residue thus obtained being less than one-thousandth part of the wine, possesses the characteristic bouquet and flavour of the wine in a high degree. It is at the same time extremely liable to change. Even when heated only to 35° or 40° it loses its characteristic odour, and assumes the smell of heated wine, and a short exposure to the influence of atmospheric air destroys the bouquet entirely, exactly as the wine itself rapidly loses its bouquet when shaken up with air. Owing to the small quantity of the extract, Berthelot was unable to examine the exact chemical nature of its different constituents; he recognized, however, the following bodies in the extract from Bordeaux and Burgundy:—A small quantity of amylic alcohol; an oil insoluble in water, perhaps œnanthic ether; a substance not volatile by itself, but slightly volatile with the ether vapour. In odour it resembles the bouquet of the wine, and, like it, is extremely unstable under the influence of heat or air. Ammoniacal oxyde of silver, as well as the tartrate of copper and potassium, are reduced by it, and when heated with liquor potassæ it becomes brown. It is readily soluble in water, alcohol, or ether. Ether takes it up from water, but it is not removed from the latter by bisulphide of carbon. It is not ordinary aldehyde. A substance slightly volatile, faintly resembling in smell that of the wine, but having no action on ammoniacal oxyde of silver, is perhaps a product of the decomposition of the former.

If the wine has not been carefully neutralized a small quantity of acid and colouring matter are also found in this etherial extract.

According to these experiments it is of the utmost importance that the finished wine be not exposed too much to the action of air, as otherwise its bouquet will be destroyed, 50 c. c. air being, according to Berthelot, sufficient entirely to destroy the bouquet of one litre of wine. The destruction of the bouquet in very old wines is most likely due to the gradual action of the atmospheric oxygen which finds its way even through the cork of the bottle.

On the other hand, if the above-given explanations as to the formation of some of the fatty acids, by the oxydation of albuminous and other substances in the wine, is correct; and if part, at least, of the bouquet, as is highly probable, is due to their presence, the action of the oxygen on the young wine is essential. It must then be left to the care and intelligence of the practical wine-producer to determine how long this action should be allowed to continue, by leaving the wine in cask, and when it ought to be stopped as far as possible by bottling, so as to bring the bouquet to its highest possible perfection.[1]

[1] In our estimation of the volatile ethers of wine, by heating the distillate from the wine with caustic soda in a closed flask, we noticed very frequently that this distillate, after the heating with the alkali, possessed distinctly the smell of somewhat faded rose-leaves. It has before been observed, that if salicylate of potassium is heated with liquor potassæ and distilled, a distillate is obtained having the characteristic smell of rose-water. Might not the above observation show the presence of salicylic acid or some analogous substance in wine?

CHAPTER VIII.

THE VARIETIES OF SUGAR OCCURRING IN WINE, AND METHODS FOR THEIR DETERMINATION.

Origin of sugar in wine.—Cane sugar, sucrose.—Grape sugar, starch sugar, dextrose or right-handed glucose.—Fruit sugar, levulose, left-handed glucose.—Invert sugar.—Quantitative estimation of sugar, Saccharometry.—Chemical method, Optical methods.—Polarizing saccharometers of Mitscherlich, Soleil, and Jellett.—Optical examination of wine for sugar.

ORIGIN OF SUGAR IN WINE.

GRAPES contain a considerable quantity of sugar. This is sometimes considered to be of a peculiar kind, but is more probably a mixture or compound in atomic proportion of two different kinds of sugar, namely fruit sugar and grape sugar. The same mixture is produced by the action of acids on cane sugar; it is then termed invert sugar.

Cane sugar is never found in grapes; it is, however, sometimes added to must or to wine—in large quantities, for example, to champagne. In either case, however, it is very soon changed into invert sugar, so that, even after the lapse of a few weeks only, cane sugar is no longer found in the wine to which it had been added.

During the fermentation of the must, the fruit and grape sugars are decomposed chiefly into alcohol and carbonic acid. Both sugars are not, however, decomposed in equal quantities, so that at the end of the fermentation generally more fruit than grape sugar is left. The sugar which remains permanently in the wine consists mainly of fruit sugar, with only a small admixture of grape sugar. The proportion between these two sugars is not, however, always the same, but seems to vary in different kinds of wine, and under different conditions of fermentation. Generally, as stated above, the fruit sugar remains in excess; sometimes, however, the grape sugar is left in greatest quantities; and under certain conditions it seems even as if grape sugar only remained behind, all the fruit sugar being decomposed. The sugar, whether fruit or grape sugar, thus left undecomposed at the end of fermentation, in pure natural wines, rarely amounts to more than 0·5 per cent., being generally much less. Even this small quantity is found chiefly in young wines, and disappears as the wine becomes aged. In fortified wines, to which alcohol is added in order to check fermentation, or in some liqueur wines made from raisins, the sugar ranges from 2 per cent. or 3 per cent. to upwards of 20 per cent.

CANE SUGAR, SUCROSE.

Cane sugar ($C_{12} H_{22} O_{11}$) is found in the juice of certain plants, especially the sugar-cane, beetroot, and sugar maple. When pure, it crystallizes in colourless, transparent crystals, belonging to the monoclinic system. It has a specific gravity of 1·606, is soluble in about one-third of its weight of cold, and even less of boiling water, insoluble in alcohol or ether. It melts at a temperature of 160° and at a temperature of 200° loses water, and becomes converted into a dark brown substance, caramel. By the action of ferments or diluted acids cane sugar is converted into a mixture of grape and fruit sugar, termed invert sugar. This change takes place instantaneously, when two parts of powdered white sugar are mixed in a mortar with one part by weight of solid yeast, and the mixture becomes fluid; the conversion by acids is effected slowly in the cold, rapidly at a boiling heat. Even an aqueous solution of cane sugar is slowly converted into invert sugar, rapidly by continuous boiling. Cold or hot alkaline solutions, if not too concentrated, are without action on cane sugar. Copper salts, in alkaline solution, are not reduced by it. Solutions of cane sugar turn the plane of a beam of polarized light to the right, the amount of rotation being proportionate to the concentration of the solution and the length of the column of liquid through which the beam passes. 15 grms. of pure dry cane sugar dissolved in water, so as to form 100 c. c. of solution, turn the plane of polarization in Mitscherlich's apparatus 20° to the right; the tube employed being 200 mm. long, and the change from red to blue taken as the measure of rotation. If the tube employed is always 200 mm. long, then the amount of rotation observed is always proportional to the quantity of sugar present in 100 c. c. of solution.

The molecular rotating power of cane sugar is 73·8° to the right. It is scarcely affected by changes of temperature.

GRAPE SUGAR, STARCH SUGAR, DEXTROSE OR RIGHT-HANDED GLUCOSE.

Grape sugar ($C_6\,H_{12}\,O_6$) is found in many kinds of fruit, and in honey, mixed or combined with fruit sugar. It is produced by the action of warm diluted sulphuric acid on starch or cellulose, is excreted in large quantities by the kidneys in a disease termed diabetes, and is separated from many substances, so-called glucosides, on their being treated with acids. Together with fruit sugar, it is formed by the action of ferment or acid on cane sugar. It crystallizes from a moderately concentrated solution in granular masses containing one atom of water of crystallization, which they lose at a temperature of 60°. If the solution be evaporated to a thick syrup, it crystallizes only after having attracted sufficient water from the atmosphere to form the above hydrate. From alcohol of 95 per cent. it crystallizes in microscopic needles containing no water of crystallization. It is soluble in its own weight of cold water, but slightly soluble in alcohol, scarcely soluble in ether. Dilute sulphuric acid, either hot or cold, is without action on it, but hot alkaline solutions readily decompose it with formation of a dark brown solution. Salts of copper are not precipitated by caustic alkalies in presence of grape sugar, but yield a deep blue solution, from which sub-oxyde of copper is thrown down, slowly in the cold, rapidly at a boiling heat. One molecule of grape sugar thus reduces 10 molecules of oxyde of copper, and this reduction may be used as a means of estimating the amount of grape sugar present in a solution. The reaction is at the same time an exceedingly delicate test: the presence of even one-thousandth part of grape sugar in a solution may be detected by the formation of a red precipitate on being boiled with a little sulphate of copper and excess of potash. Solutions of grape sugar turn the plane of polarization to the right, the molecular rotating power being 56°. It is but little affected by temperature; 15 grms. of grape sugar dissolved so as to form 100 c. c. solution turn the plane of polarization in Mitscherlich's apparatus 16·8° to the right.

FRUIT SUGAR, LEVULOSE, LEFT-HANDED GLUCOSE.

Fruit sugar ($C_6 H_{12} O_6$) is found in fruit and in honey, in conjunction with grape sugar. It is formed together with grape sugar by the action of acids and ferments on cane sugar. From a mixture of these two sugars it is best obtained by adding a slight excess of hydrate of lime to their concentrated solution, and strongly pressing the semi-fluid mass produced. The compound of lime and grape sugar being fluid is pressed out; the solid compound of fruit sugar and lime is left behind. This lime compound is next decomposed by oxalic acid, when pure fruit sugar is obtained. It forms an uncrystallizable syrup, soluble in water in every proportion, soluble in alcohol, slightly soluble in ether. Fruit sugar, like grape sugar, is not acted on by acids, but is readily decomposed by caustic alkalies, with formation of a dark brown solution. Like grape sugar, it decomposes an alkaline solution of copper salts, and in exactly the same proportion. Its solutions, however, turn the plane of polarization to the left, its molecular rotating power being 106° at 14° C. This power is much affected by temperature, and at 90° it is reduced to 53°. 15 grms. of fruit sugar dissolved so as to form 100 c. c. solution turn the plane of polarization in Mitscherlich's apparatus 31·8° to the left, at a temperature of 15° C.

INVERT SUGAR.

Invert sugar ($C_6 H_{12} O_6$) is the mixture of sugars found naturally in the grape, and is produced by the action of ferments and acids on cane sugar. It behaves like a mixture of grape and fruit sugar, being not acted on by acids, readily decomposed by hot alkaline solutions, and reducing alkaline solutions of copper salts in the same proportion as these two sugars. The two sugars, which are present in atomic proportion, may be partially separated by alcohol, more completely by converting them into lime compounds as previously described. Invert sugar turns the plane of polarization to the left, its molecular rotating power being 26° at 15° C.; the latter becomes considerably less as the temperature rises, diminishing 0·37° for each degree of temperature above 15°, increasing by the same amount for each degree below 15°. 15 grms. of invert sugar dissolved so as to give 100° c.c. solution turn the plane of polarization in Mitscherlich's apparatus, at a temperature of 15° C., 7·8° to the left.

QUANTITATIVE ESTIMATION OF SUGAR: SACCHAROMETRY.

There are two chief methods for the estimation of sugar, one chemical, the other optical.

Chemical Method.

Grape, fruit, and invert sugar reduce an alkaline solution of copper salt; 10 molecules of oxyde of copper are requisite to oxydize one molecule of either of these sugars. The analytical process based upon this reduction which gives the best results, and is generally adopted, is Fehling's. It is employed as follows:—A standard solution of copper salt is prepared by dissolving 34·64 grms. of pure air-dry sulphate of copper in about 160 c. c. distilled water; 150 grms. of neutral tartrate of potash are next dissolved in 600 c. c. to 700 c. c. caustic soda solution of 1·12 sp. gr. The solution of sulphate of copper is next gradually added to this alkaline solution, and the mixture is then made up to exactly one litre, by distilled water. 10 c. c. of this solution require 0·05 grm. of any of the above sugars for the complete reduction of the copper; the solution, which is of a deep blue, becoming thereby colourless. This standard solution is gradually decomposed, and should therefore never be kept for any length of time. When freshly prepared, it remains perfectly clear on boiling, but when partially decomposed by time it is rendered turbid by boiling, and deposits suboxyde of copper exactly as if sugar were present. If the solution of sulphate of copper and the alkaline tartrate are kept in separate solutions, and only mixed as required, they remain good somewhat longer.

In solutions containing only one or more of the above sugars, or besides these only such other substances as do not reduce copper salts, the sugar may be estimated as above, after they have been simply diluted to such an extent with distilled water, as not to contain more than one-half per cent. of sugar. Only in such dilute solutions the above proportion, between the sugar and oxyde of copper reduced, holds strictly good.

Any solution which besides the sugars contains other substances reducing the copper salt, requires previous preparation so as to remove, if possible, the interfering substance, without acting on the sugar. Moreover, colourless, or nearly colourless, solutions only can be employed with advantage.

Before, therefore, we can proceed to the estimation of sugar in the wine, some treatment is necessary to remove the colour, and some substances which also reduce copper; unfortunately the latter is only partially attainable. This latter circumstance is not, however, of much consequence in wines containing a moderate amount of sugar, but in wines containing less than 0·2 per cent. it causes frequently a considerable error, and may even make the process entirely illusory. Light white wines have merely to be shaken up with charcoal, which not only decolorizes them, but also removes tannin, and such-like substances, reducing copper salts. Dark-coloured wines and such as contain a great quantity of sugar require, however, some further preparation. The estimation of the alcohol, after the plan of Tabarie, gives us the specific gravity of the wine minus its alcohol, from which the total solid contents of the wine may readily be calculated, as elsewhere described. Wines containing less than 2 per cent. of solid matter generally require no dilution. Wines with between 2 and 4 per cent. solid constituents are best diluted with from two to five times their bulk of water; whilst wines containing upwards of 4 per cent. are diluted so as to yield a mixture containing no more than one-half per cent. of residue. Thus 100 c. c. of the first class of wines being measured out, 20 c. c. acetate of lead solution are added (the acetate of lead solution is made by dissolving one part of sugar of lead in ten parts of distilled water), and the mixture, after being well stirred, is allowed to stand a short time, and is then filtered. The clear filtrate is next shaken up with some animal charcoal and again filtered, this second filtrate being generally perfectly colourless. Sometimes, though but rarely, a little more acetate is required (which may be seen by the filtrate from the first lead precipitate giving a further precipitate, on the addition of a fresh portion of acetate of lead), or a second shaking up with a fresh portion of animal charcoal will be found necessary before a colourless solution is obtained. Of wines of the second class 50 c. c. are taken, 10 c. c. of acetate of lead solution are added, and this mixture is then diluted so as to form 100 c. c. to 300 c. c. solution: this is then filtered, shaken up with charcoal, &c., as above. Of the third class of wine 30 c. c. only need be taken, 5 c. c. acetate added, and water added so as to yield a mixture, giving about 50 c. c. solution for each per cent. of residue in the wine; it is filtered, treated with charcoal, &c. The wine is best measured by means of a pipette, and poured at once into a measure flask of the required capacity, holding, when filled up to a mark on the neck, 100 c. c., 200 c. c., 300 c. c., 500 c. c., &c. The acetate of lead is then added, and the flask is filled up to the mark with distilled water. The clear filtrate thus obtained is now fit for testing. It is sometimes recommended to render the wine alkaline with lime water before adding the acetate; this, however, should be avoided, inasmuch as in an alkaline solution grape sugar is precipitated, at least partially, by acetate of lead, and a loss of sugar is thus occasioned.

10 c. c. of our standard copper solution are now measured into a small porcelain dish, 50 c. c. distilled water added, and heat applied. The blue solution should remain perfectly clear when boiled for a few minutes. The heat is then moderated so as just to keep the solution gently boiling, and the decolorized wine is slowly poured in from a burette divided into

tenths of c. c. The addition of the wine should be so regulated that the gentle boiling is not interrupted.

A yellowish precipitate is produced, if sugar be present, generally becoming speedily red and pulverulent, so as readily to settle to the bottom. Sometimes, however, it remains of a dirty greenish colour, flocculent, or very finely divided, so that it scarcely settles down at all. This is chiefly observed in wines poor in sugar, and is most probably due to other substances than sugar, rendering the estimation of sugar in these wines by means of this test extremely unsatisfactory. The addition of wine from the burette is continued until the blue colour of the copper solution is entirely destroyed. For the purpose of observing this, the heat is moderated so as to stop ebullition and allow the precipitate to subside, when on slightly tilting the dish the colour of the supernatant liquid can be observed. The solution should not, however, be allowed to stand too long without boiling, as in the cold the suboxyde of copper thrown down is redissolved, again forming a blue solution. The point of disappearance of the blue colour may be observed with tolerable accuracy if the sugar solution employed contained not much less than 0·5 per cent. and is free from other admixtures. In the case of most wines, however, it is not easy to observe the point distinctly, because the supernatant liquid generally acquires a yellowish tint, which makes it very difficult to observe whether or no the last trace of blue has disappeared. In such cases it is advisable, as soon as the blue becomes difficult to observe, to filter a small quantity of the boiling liquid (about ½ c. c.) into a small test tube or watch-glass, and add a drop of ferro-cyanide of potassium and a few drops of diluted acetic acid; a brown precipitate or coloration indicates that there is still some copper in solution; some more wine must be added, and the boiling continued until a portion thus tested gives no longer any indication of the presence of copper. The intensity of the coloration produced by the ferrocyanide will, after a little practice, be a good indication of the amount of wine still to be added, so that generally no more than two or three filtrations are necessary. It is essential that the small fraction filtered should be perfectly clear, as, if it contains even a trace of suboxyde of copper in suspension, this will dissolve in the acetic acid, and thus copper will be found in solution, though perhaps the whole of it had been precipitated. The precipitated suboxyde is often dense and coarse enough to be readily removed by filtration through ordinary filtering-paper; sometimes, however, it is so fine that it passes even through Swedish paper, and great care is therefore required in using this test. The filtration has also to be conducted with the boiling hot solution, otherwise there is danger of redissolving some of the precipitate as previously stated. If by one of these means the point has been fixed when all the copper is reduced, the amount of decolorized wine used is read off from the burette; it gives the quantity of solution which contains 0·05 grm. of sugar, the quantity required to reduce the copper in the 10 c. c. of standard solution employed. From this the percentage of sugar in the diluted wine is calculated, which, being multiplied by the number of times the wine had been diluted, gives the percentage of sugar present in the wine. Thus let us suppose 50 c. c. wine had been diluted to 200 c. c., and that 15 c. c. of this are required to reduce the copper of the 10 c. c. standard solution employed. If 15 c. c. contain 0·05 grms., 100 c. c. will contain 0·333 grm., or

$$15 : 0{\cdot}05 = 100 : x + x = 0{\cdot}333 \text{ per cent.};$$

and as the wine had been diluted four times, the wine itself will contain 1·332 per cent. of sugar.

If less than 10 c. c. of the decolorized wine suffice to precipitate the copper from the 10 c. c. copper test, the dilution had not been enough, and a second experiment must be made with more diluted wine.

The process, as here described, estimates only the grape, fruit, or invert sugar, all of which, as previously stated, reduce oxyde of copper from its solution to the suboxyde, one equivalent of one of these sugars reducing ten equivalents of oxyde of copper. Cane sugar does not, however, reduce oxyde of copper, and cannot, therefore, be thus estimated. Cane sugar is, however, readily converted into invert sugar by diluted acids, and may therefore be estimated as such.

One atom of cane sugar becomes two atoms of invert sugar, or $C_{12} H_{22} O_{11}$ becomes $2 \times C_6 H_{12} O_6$, or 342 parts of cane sugar become 360 parts of invert sugar. The amount of invert sugar found has, therefore, to be reduced in the proportion of 360 to 342, to give the amount of cane sugar from which it was produced. For the purpose of conversion 100 c. c. of the solution containing the cane sugar are mixed with 10 c.c. of strong hydrochloric acid and heated in a water-bath for fifteen minutes to a temperature of 70° C., after which the sugar is estimated as above. In doing so it is sometimes necessary to adopt the following precaution. The reduction of oxyde of copper to suboxyde, and its consequent removal from the solution, takes place only in alkaline solutions; if then the wine is very acid, and much of it has to be added to the copper test, it may sometimes neutralize the alkali to a sufficient extent to prevent the due action of the test. In such a case it is advisable to examine whether the liquid in the dish is still strongly alkaline, and, if necessary, to add a small piece of hydrate of soda.

Cane sugar, as before stated, is rapidly changed into invert sugar in the presence of acid, and is, practically, never found in wine.

There are sometimes found in wine substances other than cane sugar, which, when boiled with dilute sulphuric acid, become converted into grape sugar. They may be approximately estimated by the amount of sugar they yield. After estimating the amount of sugar in the wine, the operator has only to heat 100 c.c. of it with 1 c.c. of strong sulphuric acid, and again to estimate the sugar. Any increase in the sugar found is due to the conversion into sugar of such glycogenetic matters.

Optical Methods for the Estimation of Sugar.

Solutions of the different kinds of sugar have the property of rotating the plane of polarized light. The degree of such rotation depends on the amount of sugar present in a certain volume of solution, the length of the column of such solution through which the light passes, the temperature of the solution, and the colour of the light. Upon this property of sugar an easy and accurate method for its estimation has been based.

An ordinary ray of light falling upon a polished surface is reflected, whatever may be the direction in which the ray falls upon the surface. If, however, such a ray has once been reflected from a polished surface (which must not, however, be metallic) under a certain angle, 35° in the case of glass, it has acquired the remarkable property of not being reflected, under all circumstances, from a second polished surface upon which it may fall.

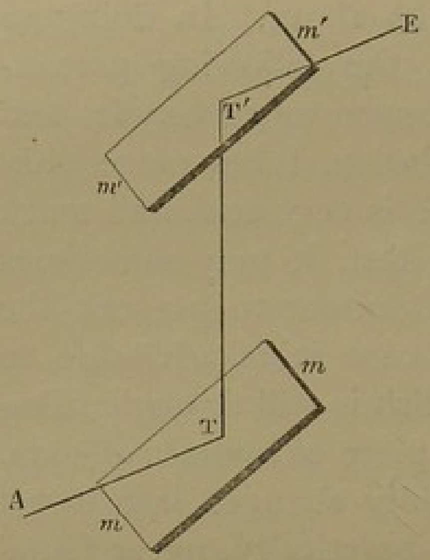


FIG. 36.—Polarization of Light by reflection.

Let *m m* be a plate of glass, on which a ray of light, A T, falls in a direction making an angle of 35° with the plane of the plate; part of the light will pass through, but part of it will be reflected in the direction of T′. Now if this ray at T′ is made to fall upon a second mirror, *m′ m′*, it will be reflected like an ordinary beam, if the planes of incidence (a plane containing both the incident beam and the perpendicular erected at the point of incidence of the beam with the mirror) of the two mirrors coincide, as in the figure. Now let the mirror *m′ m′* be turned round T T′, as an axis; it will be found that the intensity of the beam T′ E, gradually diminishes, and, as soon as the planes of incidence of the two mirrors make an angle of 90° with each other, the beam T T′ will not be reflected at all from the upper mirror. Continuing the rotation, light will again be reflected, the intensity of the reflected ray gradually increasing until the upper mirror has been turned through an angle of 180°, when the beam T′ E will again be at a maximum, the planes of incidence of the two mirrors coinciding once more. If the mirror be still further rotated, the ray T′ E will diminish again; and after a further rotation of 90°, or 270° from the first position, will once more vanish, to be again at a maximum when brought back to the first position.

During one rotation of the mirror there are, therefore, two points 180° apart, where the reflected beam T′ E is at a maximum, and two intermediate points in which it is at a minimum. The first takes place when the planes of incidence in the two mirrors coincide; the second, when they are at right angles to each other.

A ray of light which possesses the property of T T′ (being reflected or not reflected according to circumstances) is called a polarized ray. It is assumed that in such a ray all vibrations of the ether are performed in one plane, called the plane of vibration; it is at right angles to the plane of incidence in the above case: this latter is called the plane of polarization.

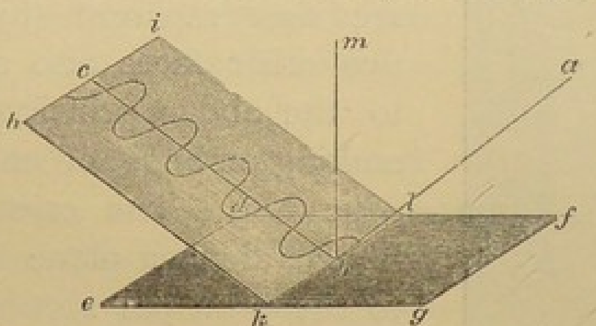


FIG. 37.—Showing the direction of the vibrations in a Ray of Light, &c., polarized by reflection. The plate *e d f g* is the reflecting mirror, *a b* the incidental ray of common light, *b c* the reflected ray of polarized light, the polarization consisting in the peculiarity that the light vibrates in the plane indicated by *h i k l*, as sketched by the undulating line.

A similar alteration in a ray of light is produced by its passage, in certain directions, through various transparent media, *e.g.* all crystals, except those belonging to the regular system. Crystallized rhombohedric calcic carbonate, called Iceland spar or double spar, shows this property of polarizing a beam of light passing through it, in great perfection. A ray of light passing through such a crystal, in the direction of the principal axis, undergoes but a single refraction; but when passing in any other direction, it is split into two rays, which emerge from the crystal in different directions. Both rays are polarized, the plane of polarization of the one being at right angles to that of the other. One of these two rays follows the ordinary law of refraction: the proportion existing between the sines of the angle of incidence and angle of refraction is constant; it is called the ordinary ray. The second does not follow that law; it is called the extraordinary ray.

For most purposes for which polarized light is employed, the existence of two rays polarized at right angles to each other is not only needless but injurious, one polarized beam being all that is required. The superfluous ray is therefore mostly excluded by mechanical contrivances, such as Nicol's prism. Let A B E G (Fig. 38) be a natural elongated rhombohedron, the axis of which passes through the corners C and E; a section through A C E G will, therefore, be a principal section.

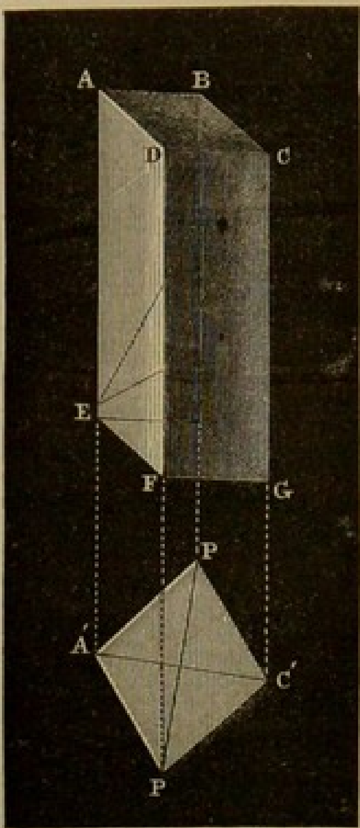


FIG. 38.—Elevation and section of an elongated prism of Iceland spar, showing the direction in which it is cut when made into a Nicol's prism.

The face, A B C D, will be at right angles to this principal section, and make an angle of 71° with the edge A E. This face, A B C D, and the opposite one parallel with it, are first replaced (by grinding) by two other faces also at right angles to the above principal section, and making an angle of only 68° with the edge A E. The crystal is next cut in two, along a plane at right angles to the principal section, and to the newly cut faces; the cuts are polished and the pieces cemented together again in their original position by means of Canada balsam. A prism thus prepared has the following property. A ray of light falling on the face A C (Fig. 39, on opposite page) parallel with the edges A E and C G, is split into two rays,—*i a*, the ordinary, and *i d*, the extraordinary one. The first strikes the layer of Canada balsam within the limiting angle, and is totally reflected in the direction *a r*; the second, *i d*, passes through and emerges as a single ray from the face E G, parallel to the original direction and perfectly polarized in a plane at right angles to the plane A C E G, the principal section (in the figure the plane of the paper), or parallel to the longer diagonal of the rhombic face A C. The plane of vibration of the ray is, therefore, parallel to the shorter diagonal of that face.

If two Nicol's prisms are placed one behind the other, light which has passed through the first prism will pass without hindrance through the second if both prisms are in similar position,—that is to say, if the principal sections of both are parallel; the light will, however, be entirely stopped by the second prism if the principal sections are at right angles to each other; in any other intermediate position, some light will pass, some will be stopped. The intensity of the ray, transmitted by the second prism, is greatest with parallel Nicols, *nil* with crossed Nicols, intermediate in all other positions.

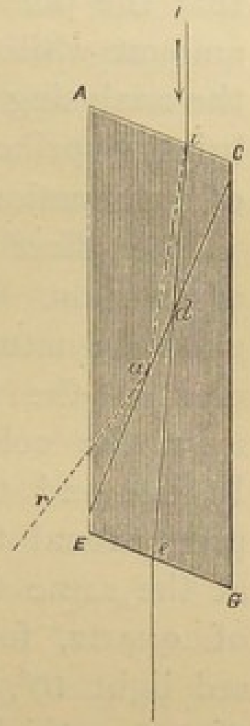


FIG. 39. — Longitudinal section of Nicol's prism through the edges A E and C G of Fig. 38; namely, through the shorter diagonal of the rhombic cross section.

Supposing now two Nicols, placed one behind the other, some distance apart, and a ray of light to enter the first prism, which we will call the polarizing prism; it will issue from it polarized in a certain direction, as before described. If, then, the second Nicol, called the analysing prism, is placed with its principal section at right angles to that of the first, the field of view will be dark, at least the central part will be black, the sides showing some light. The interposition of a piece of glass, or a tube filled with water, between the two prisms will produce no effect; the field remains dark. But if, instead of these, a plate of rock crystal (cut perpendicularly to the principal axis) be interposed, the field of view will become illuminated, and the analysing Nicol will have to be turned round a certain amount to render the field dark again; a similar effect is produced by certain liquids,—oil of turpentine, or

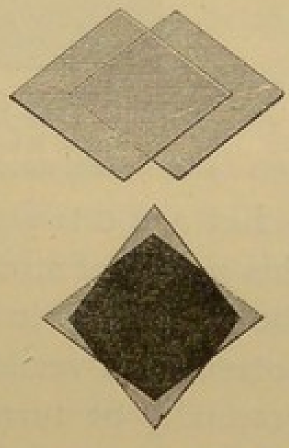


FIG. 40.—Sections of two Nicol's prisms superimposed. In the upper figure the principal sections of the two prisms being parallel, light is transmitted through both prisms; in the lower, the principal sections being at right angles, all the light which has passed through the first prism is stopped by the second prism.

solutions of sugar, for example. This experiment shows that the plane of polarization of the ray is turned a certain amount whilst passing through these solids or liquids, and the analysing prism has to be turned to the same amount to bring its principal section again into parallelism with the plane of polarization of the beam as it issues from the substance.

The effect here described is called circular polarization or rotation. The amount of such rotation depends, firstly, upon the nature of the substance; secondly, upon the thickness of the layer through which the ray passes; thirdly, upon the colour of the light, and lastly, the temperature. In one and the same substance the amount of turning is proportional to the thickness of the layer, red light being at the same time turned least, violet light most. A plate of quartz, for example, 1 mm. thick, turns the plane of red light 19°, green light 28°, and violet light 41°; a plate of 2 mm. thick giving 38°, 56°, and 82° respectively.

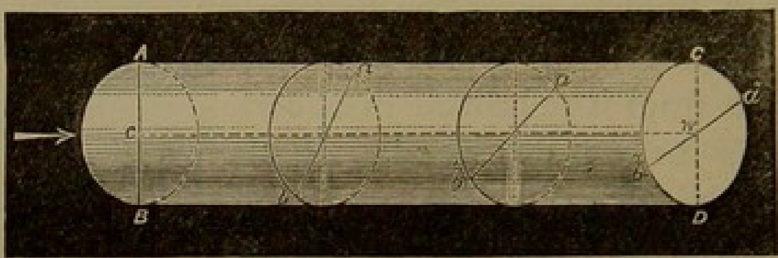


FIG. 41.—Cylinder of a substance possessing the power of circular polarization, showing how the plane of polarization A B of a ray of light, passing in the direction of the arrow, is turned (*a b*, *a′ b′ a″ b″*) in exact proportion to the length of substance passed through.

Let A B C D represent a column of a substance possessing this power of circular polarization. Let a ray of light enter the face A B in the direction *c w*, and having its plane of polarization vertical, as A B. This plane of polarization will gradually be turned the more the deeper the ray enters the substance, assuming, successively, the positions *a b*, *a′ b′*, and will finally emerge from the face C D, polarized in the direction *a″ b″*, making an angle *c w a″* with its original position. It is this angle through which the analysing prism would have to be turned so as again to extinguish the light. This angle, however, as before stated, varies with the nature of the light, being least for red, greatest for violet. It follows that if the ray entering at A B be compound light,—white light, for example,—it will on emerging from C D be separated into its components, the red portion being turned least, the violet most. If, under these circumstances, the analysing prism is turned, instead of arriving at a point of darkness, as with homogeneous light, the field of view will never become quite dark, but will be illuminated by coloured light, the colour varying with the position of the Nicol. If, in order to extinguish red, green, and violet light successively, the prism has to be turned to the right, the substance shows right-handed rotation; if, in order to extinguish the colours in the above order, we must turn the prism to the left, the substance possesses left-handed circular polarization. Whatever be the colour of the light, the amount to which this colour is rotated is generally proportional to the length and strength of active substance interposed between the Nicols. If, then, one of the different tints produced by turning the analysing Nicol, when white light is used, could be selected, which we could always readily fix upon, it would be unnecessary to employ monochromatic light. Such a tint is found at the point where the blue or violet change into red; here a very little turning of the Nicol in one direction will render the field distinctly blue; a little turning in the opposite direction will render it as distinctly red. The change of one colour into the other takes place tolerably abruptly; the analysing prism may be placed in such a manner that one side of the field is red, the other side blue, the centre a kind of violet. The position of the Nicol required to produce this central tint, can indeed be fixed with much greater accuracy than that corresponding to the point of maximum darkness; it is the point selected by Mitscherlich to measure the power of circular polarization possessed by various substances.

POLARIZING SACCHAROMETERS OF MITSCHERLICH, SOLEIL, AND JELLETT.

As will be seen from the preceding, it is necessary, in order to estimate the degree of circular polarization shown by any substance, that we should be able accurately to fix the position of the plane of polarization of a ray of polarized light. A great number of instruments have been devised to accomplish this, of which, however, a few only can here be described.

Mitscherlich's Polaroscope.—This was one of the earliest proposed, and is one of the most simple. It consists essentially of a polarizing Nicol's prism; a lens to render the rays of light parallel; a tube, closed at both ends by plate glass, to hold the solutions to be examined; and an analysing Nicol's prism. This latter is mounted in such a manner that it can be readily turned round its longest axis, whilst the degrees of the circle round which it is turned can be read off a brass plate. The instrument is used as follows:—The tube filled with pure water being placed between the Nicols, the index of the analysing prism is placed accurately on zero, and the observer, looking through the instrument towards a bright light, turns round the polarizing prism until the darkest part of the field of view is accurately central. It is best to make the observation in a dark room, and to screen off all light, except that which passes through the instrument. It is also advisable not to look through the instrument too long at a time, but to adjust at first only approximately, and then rest the eye a little before making the final adjustment. The polarizing prism is then fixed in its position by a screw, and the instrument is ready for use. The tube is emptied of the water, and then filled with the solution to be examined and replaced in its position between the Nicols. If the solution shows even a moderate degree of circular polarization, the field of view will no longer be dark, but be more or less illuminated, and show a greater or less degree of colour. The analysing prism is now turned slowly round until the blue colour of the field passes into the red; one-half of the field may be made to show red, the other half blue: the line of demarcation between these two colours should be accurately central. If, however, the solution shows but a slight amount of circular polarization, we must rest satisfied with fixing the analysing prism in such a position that the field shows a sort of pink or violet colour, which is changed to a decided blue, if the prism be turned a little to one side; and to a decided red, if it be turned towards the other. The amount of turning (rotation) given to the analysing prism may then be read off the divided circle, and forms a measure of the rotating power of the solution for this particular colour. The amount of circular polarization possessed by the various sugars described above, has been ascertained by this apparatus. The instrument is not, however, capable of great accuracy, more particularly with dilute solutions, and an error of half a degree, or even a degree, may easily be made. More accurate is

Soleil's Saccharometer.—The essential parts of this instrument are, beginning from the end placed towards the light, a polarizing Nicol; next a quartz plate cut at right angles to the principal axis of the crystal, made half of right-handed, half of left-handed quartz, the line of junction of the two dividing the field into two equal parts. After this comes the tube to hold the solution, followed by another plate of quartz, cut as above, either from left-handed or right-handed quartz. The light next has to pass through two wedge-shaped plates, cut from quartz, having the opposite rotating power of the preceding plate, and also, of course, at right angles to the axis. These wedges, by a suitable mounting, can be made to slide one over the other at right angles to the direction of the light passing through the instrument, and may thus be made to form a plate of varying thickness; the thickness due to any particular position can be read off by a scale and vernier. If the index of this scale stands at zero, the two wedges form a plate exactly as thick as the first plane parallel quartz plate, and, having the opposite rotating power, these two exactly neutralize each other. Lastly comes a second analysing Nicol. If then the index of the two wedges stands at zero, and both Nicols are in the proper position, an observer, looking through the instrument towards a bright light, will see the double plate brilliantly coloured; and if the plate be 7·5 mm. thick, the colour of the two halves will be equal, and be a tint between red and violet (*couleur sensible, teinte de passage*). A very slight turning of either the polarizing or analysing prism will at once alter the equality of the tint of the two halves. The same effect is produced by introducing the tube filled with a solution of sugar between the Nicols. The equality of the tint can, however, be again restored by either augmenting or diminishing the thickness of the plate formed by the two wedges. The rotating power of the liquid can, in this manner, be completely compensated, and the thickness of quartz-plate necessary to accomplish this is the measure of the rotating power of the liquid in the tube.

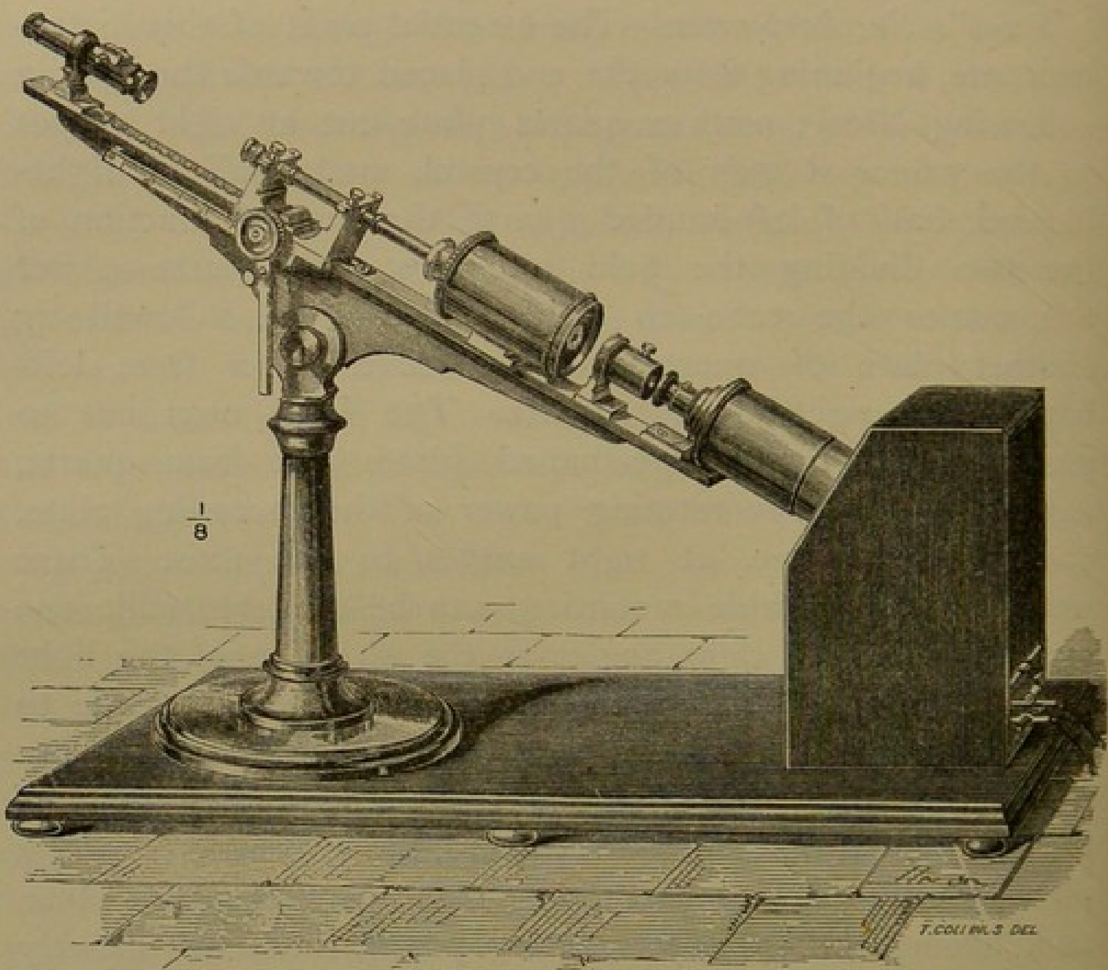


FIG. 42.—Jellett's Polarometer arranged for an experiment. The box on the right hand holds a lime-light.

Jellett's Polarometer.—All our observations were made with a polarometer, which was invented a few years ago by Mr. J. H. Jellett, Professor of Natural Philosophy in the University of Dublin. As this instrument is by far the most accurate polarometer extant, but is nevertheless little known and less used, we give a short description of it in this place, accompanied with such illustrations as will make its construction readily understood. The description will closely follow the inventor's account, as given in vol. vii. of the Proceedings of the Royal Irish Academy.

In determining the plane of polarization of a ray by means of the ordinary Nicol's prism, the observer is required to arrest the rotation of the prism at the point at which the intensity of the transmitted light is at a minimum. But it is difficult to do this with very great accuracy, inasmuch as the observer is obliged to compare a shade of colour not with any other shade which is before his eye at the same instant, but with his recollection of a shade observed a moment before. To insure any tolerable degree of accuracy the observation must be made very rapidly, so that the eye may receive the new impression while the former one is still quite fresh in the memory. The difficulty of doing this with accuracy in any case is obvious, but it is most felt in experimenting on light reflected or transmitted by fluids. For here it is impossible to touch the instrument without producing a tremulous motion in the fluid, and therefore in the image reflected or transmitted; and this motion, while it lasts, renders accurate observation very difficult. But if the rotation of the analysing prism be stopped for a sufficient length of time to allow this motion to cease, the recollection of the previously existing tint will no longer be so fresh as to allow the comparison to be made with any very great exactness. The difficulty will be increased, as is easily seen, when there is any amount of elliptic polarization in the light which is to be examined.

The remedy for this difficulty Mr. Jellett sought in the construction of an analysing prism in which the tints compared should be *simultaneous*, not consecutive. The double quartz plate of Arago was an attempt to realize this conception. It has, however, no similarity in principle to, and does not approach in accuracy, the instrument devised by Professor Jellett.

A rhombic prism of Iceland spar, whose longitudinal edge should have a length of about two inches, or a little more, is cut by two planes perpendicular to those edges, so as to form a right prism, as in the engraving, Fig. 43.

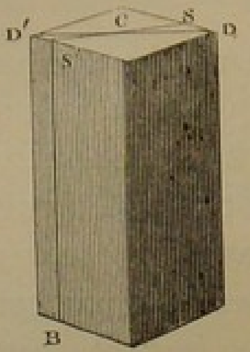


FIG. 43.—Right prism of Iceland spar cut from an elongated rhombic prism, showing the direction in which it is cut, S S′ B, for the formation of Jellett's analysing prism.

This prism is next divided by a plane parallel to the edges S S′ B, and making a small angle with the longer diagonal of the base D′ D; one of the two parts into which the prism is thus divided is then reversed, so as to place the base uppermost; the two parts are cemented together, as in Fig. 44, with the surfaces of section in contact, and the ends of the prism thus formed are then ground and polished.

Now it is evident from the construction of the prism, that if two rays of light parallel to the axis be made to traverse the two parts of the prism respectively, the lines of separation of the ordinary and extraordinary images in these two parts will be C A, C A′ (Fig. 45); and as the angle between the plane of section and the longer diagonal is small, the angle A C A′ is nearly 180°. Hence the extraordinary refractions in the two parts are in nearly opposite directions; and if the end at which the light is admitted be so chosen that these refractions shall be from the plane of section, the separation of the images will be nearly doubled.

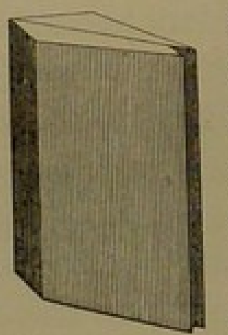


FIG. 44.—Perspective view of Jellett's analysing prism.

Now suppose a circular beam of plane polarized light to traverse the prism in a direction parallel to the sides, and so as to be equally divided by the plane of section, the emergent beam will consist of three separate parts, viz. a circular beam, O C O′ (Fig. 45), formed by the union of the two ordinary beams, and two semicircular extraordinary beams, E E′. If, then, the size of the incident beam be suitably determined, these latter may be completely separated from the ordinary beam, so as to admit of their being stopped by a diaphragm which allows the ordinary beam to pass; the instrument will then transmit a single beam of plane polarized light.

Now it is easy to see that the planes of polarization of the two parts into which the beam is divided by the plane of section are inclined to each other at an angle somewhat less than double the angle D C S (Fig. 43). Suppose, then, that the plane of the paper being perpendicular to the beam, the traces of these planes of polarization are represented by A B, A′ B′ (Fig. 46), and let C P and C P′ be perpendicular to these lines respectively.

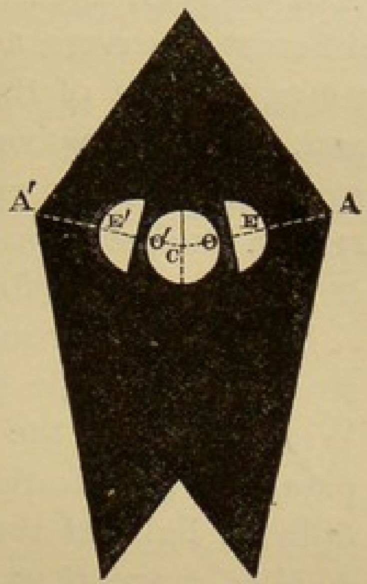


FIG. 45.—Section of Jellett's analysing prism.

Let Cp be the plane of polarization of the ray to be examined. Then so long as there is any difference between the angles P Cp, P′ Cp, the intensities of the two parts of the beam will be different, and conversely, if these intensities be equal, it is evident that the required plane of polarization will bisect the angle P C P′. The prism must therefore be turned on its axis until the equality of tints be established, and, when this is done, the position Cp of the plane of polarization is known. It is not, however, necessary to determine the position of the planes P C, P′ C. The observer commences by transmitting a beam whose plane of polarization is known, and turning the analysing prism until the tints become equal. The beam whose plane is required is then introduced, and, when the equality of tints has been re-established, the angle through which the prism has revolved, read off on a graduated circle, gives the inclination of the required plane to the known plane. This mode of determining the zero, a process which for perfect accuracy ought to be repeated with each new set of observations, possesses the advantage of eliminating the personal equation of the observer. In examining a beam of

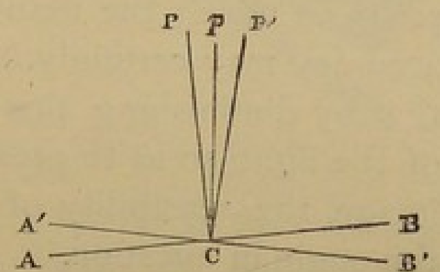


FIG. 46.—Diagram of the pla s of polarization in Jellett's prism.

any considerable magnitude, there will be found in different persons a tendency to think one part of the image darker than another, even when there is no real difference. With different observers, and even in the same person at different times, the part of the image thus preferred may be different, and, if the zero were determined once for all, this might occasion sensible error; but, as in the method here given such a preference will equally affect the position of the zero it can have no influence on the final result.

In the first prism which Prof. Jellett caused to be constructed the angle between the planes C P, C P′ was about 7°. With this prism the range of error in the determination of a plane of polarization was 7′, the light employed being the diffused light of the sky. Although this was a very much smaller range than he had ever been able to obtain with a Nicol's prism, it seemed that a greater amount of accuracy might be obtained, and, as the brightness of the image appeared to be too great, a prism was constructed in which this angle was but half of its former value. With this prism and with the same kind of light the position of a plane of polarization could be determined to 1′. With direct solar light and a prism in which the planes are still closer, a greater degree of accuracy may certainly be obtained; in fact, it can be shown that by diminishing this angle and increasing the brightness of the light, so as to preserve unchanged the intensity of the image, the sensibility of the prism will vary as cot $\frac{\delta}{2}$, δ being the angle in question.

The prism here described is fixed in the eyepiece or analyser of the apparatus, the general aspect of which is given in Fig. 42, p. 240. But while the rotation of the prism necessary for determining the zero-point is effected by little screws fixed to the tube a little below the ring by which the eyepiece is fixed to the beam on which the axis of the instrument is carried, the mechanical rotation of the analyser for the finding of any particular plane is altogether dispensed with, and this function is transferred to a fluid which has the power of turning the plane of polarization in a direction opposite to that which it is intended to determine in the casual observation. Any fluid may be used which possesses the opposite circular polarization and the same dispersive power as the solution to be examined. Of this polarizing fluid the rotating index per inch, tenth, or hundredth of an inch, is ascertained as expressed in per cents. of sugar contained in solution in the analysing tube. The analysing tube dips into and moves up and down in the compensating fluid. This arrangement will be more intelligible by the aid of the subjoined Fig. 47.

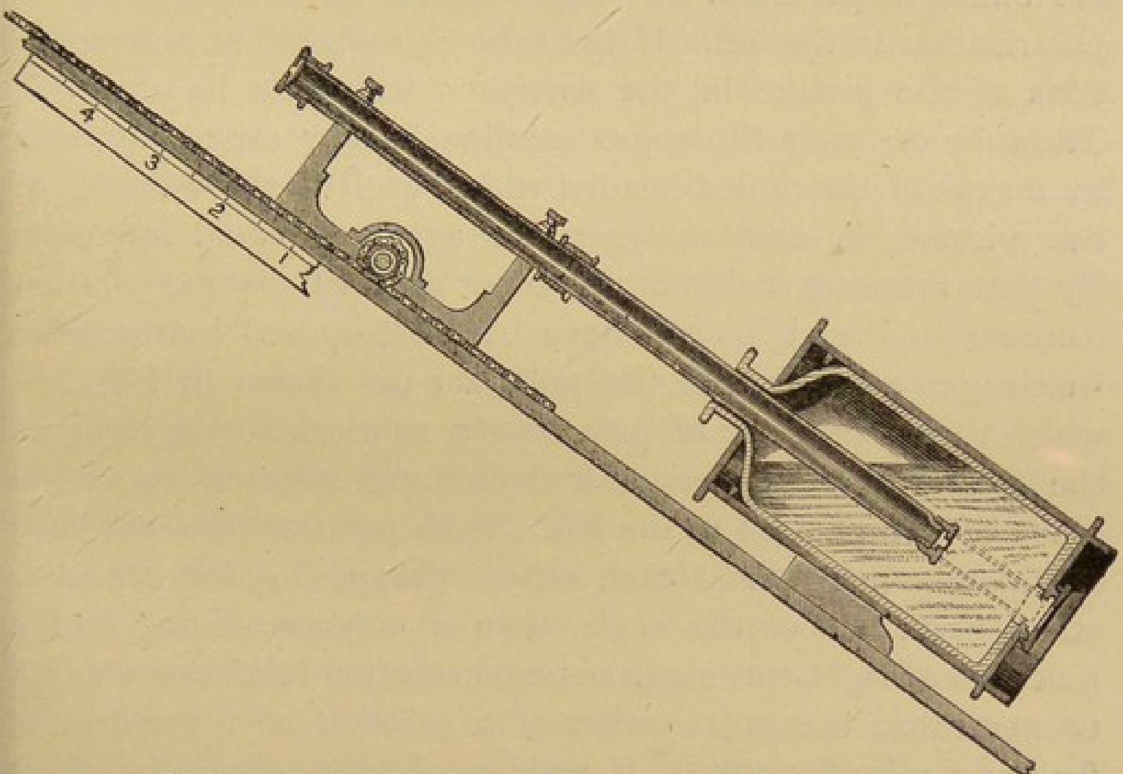


FIG. 47.—Section of compensating bottle, &c. of Jellett's Saccharometer.

The order of events in an actual analysis is as follows:—

Finding of the zero-point.—A beam of parallel light produced in the closed box at the end of the apparatus, by means of the oxyhydrogen-calcium light and a compound condenser, is thrown in the direction of the optical axis of the apparatus. It passes first through the polarizing prism. The polarized beam then enters the bottom of the compensation-bottle which contains a solution of pure cane sugar of 10 per cent. strength. The long tube containing water is pushed down to the bottom of the bottle, until its glass plate rests upon the glass plate of the bottle. The arrow of the indicator is placed upon the zero-point of the scale attached to the side (of which a portion is represented in Fig. 42, p. 240, and Fig. 47, p. 245), and the analysing eyepiece is now turned until the tints of the half-circles of its picture are equal.

(2.) *Finding of the index of the* 10 *percentic cane-sugar solution as expressed in per cents. of fruit sugar.*—The tube containing water, and intended to contain the fluid to be analysed, is now filled with a solution of pure fruit sugar containing 1 per cent. of sugar, which turns the plane of polarization to the left. If the tube be replaced as before, the tints of the picture in the analyser will now be unequal. The tube carrying the sugar solution is now raised upwards by means of the milled-headed wheel, until the two halves of the picture in the analyser are again of equal intensity. By that means a column of 10 per cent. cane-sugar solution (turning to the right) will have been interposed between the fruit-sugar solution and the polarizer (as shown in Fig. 47), which turns the plane of polarization as much to the right, as the tube full of 1 percentic fruit-sugar solution turns the plane of polarization to the left. Both polarizations will have completely neutralized each other. Supposing the arrow to stand upon 1·5 of the scale, then a column of one and a half inch of right-turning cane-sugar solution has been required to neutralize the polarization of a solution of 1 per cent. of fruit sugar in the tube. If now a solution containing either more or less sugar be placed in the tube, a longer or shorter column of cane-sugar solution will be required to neutralize its effects. And, as the effect of a column of one and a half inch (in the above example) is known to indicate 1 per cent., the effect of any length, or its sugar-indication, can be found by the equation $1·5 : 1 = t : x$, in which t is the length of the cane-sugar column measured on the scale, and x the percentage of fruit sugar contained in the problematical fluid in the tube. We have not entered upon the description of minor details of the construction of this apparatus, such as the chain in connection with the milled wheel, by which the closed tube is moved up and down in the compensating bottle, or the long lever attached to the milled wheel for delicate adjustment. These must be studied upon the apparatus itself, and, like the entire instrument, will be found to leave nothing to be desired in respect of mechanism. No other polarometer approaches this instrument in accuracy for saccharometrical purposes; as, with care, it indicates 0·01 per cent. of sugar.

OPTICAL EXAMINATION OF WINE FOR SUGAR.

The optical examination of a wine for sugar is conducted as follows. To 100 c. c. wine 20 c. c. of a solution of plumbic acetate are added ; the mixture is well shaken, and, after standing a short time, filtered. The filtrate, which is frequently still slightly coloured, is shaken with a little animal charcoal and again filtered. The colourless and bright liquid is filled into the tube of the saccharometer, and the length of the column of compensating liquid required is determined. The length thus found must be increased by one-fifth on account of the 20 c. c. plumbic acetate added to the wine. The same filtrate, after suitable dilution, as before described, is used for the chemical test. As nearly all wines turn the plane of polarized light to the left, the liquid usually employed as compensator must be a 10 per cent. solution of pure cane sugar in spirit of 30 per cent. Such a solution may be kept for a considerable length of time without sensible alteration in its power of rotation. When a left-handed liquid is necessary, oil of turpentine has to be employed. In our experiments one inch of the sample of oil used compensated 4·177 inches of the above 10 per cent. sugar solution. It was found that one inch of such a 10 per cent. sugar solution compensated the effect of, and therefore indicated 0·632 per cent. of fruit sugar and 3·003 per cent. of invert sugar in the 10-inch tube, and equalled in rotating power 1·196 per cent. of grape-sugar solution in the 10-inch tube.

It follows from this, that a solution holding 1 per cent. of fruit sugar, when placed in the 10-inch tube, requires 1·502 inches of the 10 per cent. cane sugar to be compensated. A solution holding 1 per cent. of invert sugar requires 0·333 inches of the 10 per cent. cane sugar to be compensated.

While a solution holding 1 per cent. of grape sugar, when placed in the 10-inch tube, is equal to 0·836 inches of this 10 per cent. solution.

Now, if one variety of sugar only were present in wine in a pure state, it would be necessary to multiply the number of inches or fractions of an inch of the 10 per cent. cane-sugar solution necessary for compensation by 0·632, 1·196, or 3·003 respectively, to obtain the percentage of either fruit, grape, or invert sugar present. Wine, however, contains a mixture of fruit and grape sugar (not invert sugar), and the amount of circular polarization shown by such a mixture of course depends upon the proportion of these two sugars present. As one part of grape sugar turns about as much to the right as $\frac{1}{2}$ part of fruit sugar turns to the left, a mixture of these two in this proportion would thus show no polarization at all; the mixture would turn to the left if more fruit sugar were present, to the right in presence of more grape sugar; but, whatever be the proportion between them, $\frac{1}{2}$ part of fruit sugar will always neutralize the optical effect of one part of grape sugar, and only the excess of either will have optical effect. If the proportion between the fruit and grape sugar present in wine were always the same, it would be possible to fix a relation between the amount of circular polarization shown and the quantity of sugar present, and a single optical observation would enable us to estimate that quantity. If, on the other hand, the proportion between fruit and grape sugar were variable, the optical test alone would be valueless as an indication of quantity. Chemically, however, these two varieties of sugar act alike, and, whatever therefore be the proportion of the two present, the sum of their quantity can be estimated chemically, and this, coupled with the optical test, enables us to calculate the proportion of fruit and grape sugar present in any mixture.

Let x be the per cent. of fruit sugar; y, that of grape sugar; b, that of the two sugars as estimated chemically; and let a be the number of inches of 10 per cent. cane-sugar solution compensating b. Then

$$x = \frac{a + 0{\cdot}836\, b}{2{\cdot}338}$$

and $y = b - x$.

If the mixture turns to the right, then the number of inches of 10 per cent. cane sugar having the same rotating power must be calculated and entered as a negative quantity in the above equation, or,

$$x = \frac{0{\cdot}836\, b - a}{2{\cdot}338}$$
$$\text{and } y = b - x.$$

Thus it may be calculated from the figures given that a solution containing 2 per cent. of invert sugar requires 0·666 inches of the 10 per cent. cane sugar for compensation, and putting these values into the above formula we have

$$x = \frac{0{\cdot}666 + 2 \times 0{\cdot}836}{2{\cdot}338} = \frac{2{\cdot}338}{2{\cdot}338} = 1;$$

and y of course also 1, showing that invert sugar contains fruit sugar and grape sugar in equal proportion.

It is this same invert sugar which is present in grapes; it is not, however, according to our experiments, present in wine.

Thus it was found that in a number of pure natural wines from the Rhine and Gironde, which contained a sufficient amount of sugar to admit of accurate estimation, both chemically and optically, one inch of the 10 per cent. cane-sugar solution indicated, in the mean, 1·057 per cent. sugar as determined chemically. The above formula will, therefore, give

$$x = 0{\cdot}805 \text{ per cent.}$$
$$y = 0{\cdot}252 \text{ per cent.}$$

or, for one part of grape sugar, 3·19 parts of fruit sugar were present, showing a considerable preponderance of the latter.

Very nearly the same proportion was found to exist in a sample of fine old Madeira, which had been fifty years in bottle. In this one inch of the sugar solution indicated 1·024 per cent. sugar as estimated chemically, or—

$$x = 0{\cdot}793$$
$$y = 0{\cdot}231$$

so that for one part of grape sugar 3·43 parts of fruit sugar were present.

Again, a somewhat similar condition was found in six high class port wines, in which, on an average, one inch of the 10 per cent. cane-sugar solution indicated 1·179 per cent. of sugar, or

$$x = \cdot 849$$
$$y = \cdot 330$$

so that for one part of grape sugar there are 2·57 parts of fruit sugar present.

In some other wines, however, the relation between the optical characters of the sugar and its amount was very different.

Thus one inch of the 10 per cent. cane-sugar solution indicated the following percentages of sugar:—

1·971	per cent.	in a sample of	cheap port.
2·110	,,	,,	fifty-year-old high class sherry.
4·329	,,	,,	Marsala.
4·617	,,	,,	cheap sherry.
6·512	,,	,,	Elbe sherry.

Or one part of grape sugar was associated in each of these wines respectively with—

1·35 parts of fruit sugar.	0·84 parts of fruit sugar.
1·26 ,, ,,	0·81 ,, ,,

0·73 parts of fruit sugar.

In the case of the last three samples so-called saccharine had no doubt been added.

If the proportion of fruit sugar sinks to about half that of grape sugar, the wine shows no polarization at all, for the left-handed polarization of the fruit sugar is then just neutralized by the right-handed one of the grape sugar. This condition was found to exist in a sample of natural port, in which chemical tests showed the presence of 0·177 per cent. sugar, whilst not a trace of polarization was perceptible when examined in Jellett's saccharometer. When the proportion of fruit sugar sinks still lower, the wine begins to turn to the right. In such a case it is usually assumed that grape sugar has been added to the wine: we have, however, met with several samples of wine, to which, as far as we could learn, no such addition had been made, and which, nevertheless, turned to the right. These samples were young wines, and, having been kept for some time in rather too warm a place, had entered into a state of fermentation in the bottle: the remaining sugar turned to the right. The following observation may perhaps serve to throw some light on these cases. A sample of Geisenheimer Rothenberger (a very high-priced cabinet wine, and therefore not likely to have anything added to it) had been kept in the same room with the above, and, like them, had begun to ferment. When first examined it turned distinctly to the left, requiring 0·28 inches of 10 per cent. cane-sugar solution for compensation: the sugar was at that time (January) not chemically examined. Eight months afterwards (in September) the wine was again examined; the bottle containing it had during this time stood upright in the laboratory. Fermentation had entirely ceased, but the wine contained distinct traces of aldehyde, and, according to chemical analysis, still contained 0·154 per cent. sugar: this, however, turned to the right, equivalent to 0·104 inches of 10 per cent. cane-sugar solution (being compensated by 0·027 inches left-handed turpentine), and consisted therefore of 0·144 per cent. grape sugar and 0·010 per cent. fruit sugar. The latter had therefore almost entirely disappeared. It is thus made probable that, while under ordinary circumstances of fermentation the residual sugar is chiefly fruit sugar, under certain special conditions the grape sugar is chiefly preserved, and its presence in wine must not necessarily be taken as indicating any adulteration.

The sugar contained in Champagne is chiefly invert sugar, formed by the action of the acids in the wine on the cane sugar added in the liqueur. Thus, in a sample of Champagne examined, 1 inch of 10 per cent. cane-sugar solution indicated 2·935 per cent. of sugar as tested chemically, a proportion which corresponds almost exactly to invert sugar.

The foregoing experiments show that neither the chemical nor the optical examination of the wine is by itself sufficient to afford a clear insight into the nature of the sugar present. The chemical test alone will indeed give the amount of sugar present, but leaves the nature of the sugar quite undetermined.

The optical test, on the other hand, is valueless as an indication of the quantity of sugar present, and cannot even be relied on as a qualitative test. It is only by the employment of the optical and chemical test jointly that both the quantity and quality of the sugar present in wine can be ascertained.

Cane sugar is only rarely found in wine, as when added it is speedily converted into invert sugar. Its presence or absence may be shown by heating the wine for some time with a solution of caustic potassa. Fruit and grape sugar are decomposed by the alkali; cane sugar remains unaltered, and is detected (after decolorizing, &c.) by its power of right-handed polarization, which may be changed into left-handed by heating with 10 per cent. of strong hydrochloric acid.

In a sample of Rhine wine a substance was found resembling fruit sugar in its behaviour, but being somewhat more difficult to decompose by heating with an alkaline solution, and not reducing the copper solution so readily as this sugar. It was unaffected by heating with dilute hydrochloric or sulphuric acid. The dry substance, which showed no sign of crystallization, was slightly soluble in spirit of wine, very slightly soluble in a mixture of alcohol and ether; in either case the portion dissolved and the residue showed the same power of circular polarization. Assuming that this substance reduced the copper solution in the same proportion as grape sugar, the wine contained 0·647 per cent. of it, which gave a right-handed rotation, compensated by 0·64 inches left-handed turpentine, or equivalent to 2·673 inches of 10 per cent. cane-sugar solution. The rotating power of this substance would then be nearly five times as great as that of grape sugar. The quantity of wine in our possession was too small to allow a more careful examination of the substance to be made, and we could not learn by inquiry whether anything had been added to the wine.

CHAPTER IX.

FATTY, COLOURING, ALBUMINOUS, ASTRINGENT, EXTRACTIVE, AND MINERAL CONSTITUENTS OF WINE.—ANALYTICAL TABLES.

Glycerine.—Colouring matters.—Ammonia.—Albuminous matters.—Estimation of ammonia and albumen in wine by Wanklyn and Chapman's process.—Tannin.—Extractives.—Mineral constituents.—Estimation of ash.—Analysis of ash.—Total solid constituents.—Instruments and chemical reagents necessary for the performance of an analysis of wine.—Syllabus of analysis.—Tables exhibiting the results of the analyses of various wines from the principal wine-producing countries.

GLYCERINE.

GLYCERINE ($C_3 H_8 O_3 = C_3 H_5, H_3 O_3$) is one of the constituents of animal and vegetable fats, from which it may be prepared by saponification or by decomposition with superheated steam; in both cases the fat takes up three molecules of water, and breaks up into fatty acid and glycerine. It is formed in small quantity during the fermentation of sugar, and has also been prepared artificially. It is a colourless, syrupy, sweetish liquid, of 1·27 spec. gr., soluble in every proportion in water and alcohol, insoluble in ether. It boils at 275—280° C., but suffers partial decomposition, producing pungent vapours of acrolein; it may, however, be distilled without decomposition in a current of superheated steam at a temperature of about 230° C. When heated with substances having a strong affinity for water, phosphoric anhydride for example, it is converted into acrolein ($C_3 H_4 O$). By the long-continued action of yeast and water it is converted into propionic acid. When carefully oxydized, it yields glyceric acid. It is a tridynamic alcohol, containing the tridynamic radicle $C_3 H_5$.

Like other alcohols, it forms with acids compound ethers. Natural fats are such ethers, in which the three atoms of hydrogen are replaced by acid radicles. These fats, and other analogous substances, may be made artificially by heating the glycerine and acid in glass tubes closed by fusion.

A certain proportion of sugar is, during fermentation, transformed into glycerine; 100 parts of cane sugar or 105·26 parts of grape sugar yield 3·64 parts of glycerine. It should, therefore, always be present in wine in the proportion of about one-fourteenth part of the alcohol, and must exercise no inconsiderable influence on its taste by rendering it slightly sweetish. The method proposed by Pasteur, for the detection and estimation of the glycerine in wine, is as follows: Half a litre of wine is shaken with forty grms. of animal charcoal, and, after standing for twenty-four hours, filtered. The charcoal is well washed with cold water, and filtrate and washings are evaporated on a water-bath to 200 c. c. At this point they are neutralized with hydrate of lime, and then evaporated to dryness. The residue is treated, in the evaporating dish, with a mixture of two parts of ether and one part of alcohol, which dissolves only the glycerine, with scarcely a trace of anything else. The etherial solution is evaporated on a water-bath, and finally dried *in vacuo* over oil of vitriol; the residue, consisting mainly of glycerine, is then weighed. We have, however, found that the residue thus obtained is never pure, but contains notable quantities of fruit sugar, if such is present in the wine, as well as various other extractive matters, and cannot therefore be taken as an accurate measure of the amount of glycerine present.

Pohl has suggested that the difference between the total amount of residue found by evaporation and drying, and the amount of such residue calculated from the specific gravity of the wine deprived of its alcohol, minus a certain correction for other volatile constituents, which he proposes to fix provisionally at 0·1 per cent., might be taken as a measure of the glycerine present. He has at the same time pointed out several sources of error to which this method would be liable; and our numerous analyses of wine given in the tables, in some of which the total amount of residue found by evaporation, &c. is less even than the sugar alone, show that this method is totally inapplicable. If once we are able accurately to estimate the amount of glycerine present in a wine, we shall be in a position to determine its influence on the character of a wine, and to show how the quantity is affected by the nature of the grapes or of fermentation, or by the age of the wine. Until such a method is found, we can only speculate upon the probable influence of glycerine upon the character of a wine.

COLOURING MATTERS.

There are some varieties of wines which are almost colourless, such as Champagne and certain kinds of Moselle; others are purely yellow, like old Sauternes. Then we have all varieties of shade up to dark brown. These colorations are produced by the oxydizing effect of the air upon certain matters contained in smaller or larger quantity in grapes, viz. the so-called extractives, or bodies not yet known in a distinct and isolated form, and the tannic acid which is extracted by the juice or wine from the husks, kernels, and stalks. The wine during fermentation and rest in the cask also extracts tannin from the oak. Now, just as raisins during drying assume a brown colour, which becomes a light yellowish brown in any dilute watery or alcoholic extract, so the wine during ripening becomes darker in colour, and, in many cases, sheds a brown deposit—the fully oxydized extractive matter and tannin, which is incapable of remaining in solution.

For the presence and identification of the extractive matters we have at present no test, but the tannin may be recognized by the tests described in the paragraph relating to it.

The oxydation of some of the extractive matters can sometimes be observed to take place rapidly in young rich wine, which has been prematurely bottled and is then exposed to the air. This phenomenon on the Rhine is called "Rohnig werden des Weins." When a glass of such wine is poured out, it changes its colour within a few minutes, so as to attract attention. When such wine is filled into a white glass bottle and allowed to stand open, it will become brown on the surface, and the colour will gradually descend to the bottom of the flask. The upper layers will, after some days or weeks, be actually blackish brown; ultimately, a dark deposit falls. During this process the alcohol is oxydized to acetic acid. The phenomenon is due to the fact that the wine has not been sufficiently in contact with air, and that therefore its extractive constituents have not been sufficiently precipitated during fermentation, and now absorb the oxygen they want. Such wine must therefore be brought into contact with much air at lower temperatures, and, when the oxydation is completed, be bleached with sulphurous acid. This rapid change of colour is observed sometimes upon all kinds of white wines, upon Graves, Barsac, Haut-Sauternes, Rhenish, and Hungarian wines; it denotes, in the opinion of Pasteur, the presence of decomposing fungi in the wine.

The colour of simmered wine is much darker than that of wine which has not been heated, because the higher temperature effects a quicker oxydation, and produces some new matters by the influence of acid upon sugar. This coloration of simmered wine is imitated by the makers of artificial wine, by adding to the liquid a quantity of burnt sugar or caramel. Those who drink brown sherry or brown brandy, and prefer them to the pale varieties, unwittingly protect a practice which will always detract a little from the purity of the taste of the wine or brandy.

While the colour of yellow and brown wines seems to be due to oxydized tannin and extractive matters, and not to any particular colouring matters, the tints of all kinds of red wine, whether they are slightly rose-coloured or almost black and impenetrable to light, are produced by peculiar colouring matters deposited originally either in the pulp or in the husk of the grapes. The *soluble colouring matters* contained in the pulp of grapes produced by such varieties of vines as the "Teinturier," which is extensively grown in France and Spain for the purpose of producing wine of deep colour for dyeing, have never yet been examined. They differ, of course, greatly from the colouring matter deposited in the husks of grapes, particularly by the evident fact of their *solubility* in the juice of the grapes, in which the dye of the husks is *insoluble*. This soluble colouring matter is more closely related to that contained in the juice of elderberries and black currants. As it enters into the composition of most Spanish, Portuguese, South French, and Central French red wine, we have, on attempting to extract the colouring matters, to deal with a mixture. This we might easily separate, if the colouring matters retained their original properties, but such is not the case. Until, therefore, the pigments of the several varieties of grapes have been separately examined, the chemistry of the colouring matters of red wine is not likely to make much progress. Mulder has made the first and best researches on this subject; he selected a common Bordeaux wine for his examination, but the varieties of grapes from which it was made are not stated. Being a wine sold in Holland, we may suppose that it was a mixture of Vin de Palus and of Vin du Midi, such as is commonly made at Bordeaux for the Dutch market. We have repeated the process upon a large quantity of a similar wine, and can confirm the results obtained by Mulder. It is as follows:—

The wine is precipitated by means of lead acetate, and the pale blue precipitate is collected on a filter or washed by decantation; the first washing water has an acid reaction and a pale violet colour, but the following portions become neutral and colourless. The precipitate is now treated with hydrothion and again washed: at first much acid red-coloured liquid is removed, but, after a time, the washings become colourless and neutral. The bluish black mass retains the colouring matter in the same manner as animal charcoal retains such matters. The mass is now boiled with water, in order to extract some products which are less soluble in cold water than in hot, and is then extracted with a mixture of alcohol and strong acetic acid. This alcoholic acetic solution of the colouring matter is now evaporated, when it at first becomes red like wine; as the alcohol evaporates further it becomes violet; and, lastly, when only little acetic acid remains, beautifully blue. The residue is dried completely, and a little fat contained in it separated by ether. Any trace of lead which may remain with it can be removed by a little dilute acetic acid, whereupon the colouring matter will remain in a pure state.

The colour of the dry substance is bluish black, like black-lead; its structure is amorphous. It is insoluble in alcohol, water, ether, chloroform, bisulphide of carbon, oil of turpentine, and oil of olives.

It is soluble in alcohol, containing a trace of acetic acid, and the saturated solution has a blue colour; more acetic acid makes the solution red. In alcohol and tartaric acid it is also soluble with a red colour. The presence of any of these acids in ether or chloroform does not cause it to dissolve in either of these agents. A red solution in alcohol and tartaric acid will, after complete neutralization of the acid by ammonia, become blue, after having for a moment shown the colour of chromealum; any other alkali will have the same effect; acids restore the red colour. If a slight excess of ammonia be added to the acid alcoholic solution, the colouring matter becomes *green*. If an acid be now quickly added, the red colour is restored, but not with the same intensity as before; and, if the ammonia is allowed to act upon it for a few moments, or an excess has been used, the subsequent addition of an acid does not any longer restore the red colour, but produces only a brown tint. The colouring matter has been decomposed. Almost the same reactions are observed upon all red vegetable juices, particularly of fruit. Fixed caustic alkalies effect the destruction as certainly as, and quicker than, ammonia. Strong acids do not much affect the pigment, but hot nitric acid destroys it. Chlorine water decolorizes it, and leaves a brown liquid; excess of chlorine makes the solution yellow.

The phenomena observed during the action of chlorine have induced Fauré to assume that there are two colouring matters present in the preparation obtained by Mulder's process. But Mulder denies this, and believes the reaction to belong to the pure colouring matter.

When the alcohol and tartaric acid solution is mixed with silver nitrate, it becomes deeper red; with sublimate, pale;

with mercurous nitrate, not changed; with tin chloride, darker red and slightly violet; the tartrates of the metals are precipitated colourless. Acetate of alumina gives a violet shade to the solution.

The colour of wine is determined by two factors, the amount of the blue colouring matter present, and the quantity of free acid which acts upon it. The more free acid is present, the more red will the wine appear; and with the decrease of the acidity, the colour will approach towards the violet.

The colouring matters in Burgundy, Bordeaux, and Oporto wine behave essentially in the same manner when subjected to the above proceeding, and it is difficult to explain this, particularly with regard to port, which always contains a proportion of the juice of the "Teinturier" besides the ordinary red matter from the husks of the large black grapes. When port wine is precipitated with lead acetate, a dirty-coloured deposit is obtained. This is washed until the water is colourless, decomposed with hydrothion, and again washed with water. It is then heated with warm alcohol and tartaric acid, and yields a tincture of the original colour of port wine, which is redder if the wine be young, or browner if it be old. This liquid is digested with calcium carbonate, evaporated to dryness on the water-bath, and then heated with water, until the last traces of acid reaction disappear. On now being boiled with water, it yields on filtration a brown liquid containing the oxydized or changed tannin, while the insoluble tartrate of calcium retains the red colouring matter. The latter may be extracted by means of alcohol and tartaric acid.

The crust which port wine forms in bottles contains oxydized tannin in an insoluble state, and colouring matter probably also in a changed state. The changed tannin combines with the colouring matter like the lead oxyde.

The colouring matter seems to be rather stable in the precipitated state, for it can be prepared with all its characteristic properties from old crude red tartar.

There are added to wine in various parts of the world other natural dyes; nay, even some red wine is made of white wine coloured with a vegetable pigment not being the product of any vine at all. Black cherries are a favourite dye. Next come elderberries, the production of which for this purpose is something enormous. Bilberries are used in many parts, but the great drug is Brazil wood, or logwood. It is probable that chemical and spectral analysis will soon be able to detect those several adulterations. Brazil wood, and particularly elderberry juice, have peculiar spectra while fresh, but lose their absorption bands to a great extent by time and standing. But if larger quantities of adulterated wine are examined, even after some time, some of the peculiar ingredients can still be discovered. Sorby has lately instituted researches into this matter, which, when complete, will be an interesting addition to our knowledge on this difficult subject.

AMMONIA.

Small quantities of ammonia are present in the grape-juice, or are formed during fermentation out of the albuminous substances of the juice. The greater part of this ammonia is precipitated during the progress of fermentation as ammonio-phosphate of magnesia. An extremely minute quantity, however, remains in the wine, and can be isolated and estimated as follows :—

100 c. c. of wine are introduced into a retort, 200 c. c. water are added, and about 100 c. c. distilled off. The residue in the retort is next rendered slightly alkaline by carbonate of soda, and the distillation resumed, 100 c. c. being again driven over, of course into a new receiver. In this second distillate the ammonia may be estimated either by very careful titration with $\frac{1}{50}$ normal sulphuric acid, or by Nessler's process. If the wine contains much sugar, care must be taken to add a sufficient amount of carbonate of soda, so as to keep the wine alkaline at the end of the distillation.

In some wines the ammonia is accompanied by minute traces of trimethylamine.

ALBUMINOUS MATTERS.

Grapes contain albuminous substances, which, like all such, are extremely liable to undergo decomposition, and to induce decomposition in other substances in contact with them. When exposed to the air by the crushing of the berry, they absorb oxygen and yield the ferment under the influence of which the sugar is transformed into carbonic acid and alcohol: this ferment is absorbed by the yeast, rendered insoluble, and thus removed from the wine. Properly fermented white wines contain very little of this albuminous substance, and are but little liable to further change. In imperfectly fermented wines, on the other hand, some of this albuminous substance remains dissolved, and renders them liable to fresh fermentation. All red wines, owing to their having fermented with the husks, contain, when young, much albuminous substance, which is preserved from change by the tannin present. In the course of time the greater part of it is thrown down with the colouring matter and tannin.

Detection of Albumen.—New white wines, not thoroughly fermented, and most red wines, give a precipitate, when mixed with strong chlorine water, which is probably some chlorinated albumen. If half a litre of wine is taken for the experiment, the precipitate may be collected on a weighed filter, dried, and weighed, and will thus furnish a means of estimating the amount of albuminous substance present. White wines, thoroughly fermented, or when some years old, do not contain this kind of albuminous substance; they remain, consequently, clear when mixed with chlorine water. They are not, however, on that account entirely free from such matters, as is shown by the amount of nitrogen they evolve when subjected to elementary analysis, or to the process employed for the examination of water by Wanklyn and Chapman.

ESTIMATION OF AMMONIA AND ALBUMEN IN WINE BY WANKLYN AND CHAPMAN'S PROCESS.

About 1200 c. c. of pure distilled water are put into a large flask or retort, connected with a condenser; 2 grms. carbonate of soda are added, and about 100 c. c. distilled over. This distillate is tested with Nessler's reagent, and if not found free from ammonia, another 100 c. c. must be distilled, and again tested, and this has to be repeated until the distillate is found free from ammonia.

After the water in the flask has cooled somewhat, 10 c.c. wine are added, and the distillation is recommenced, 400 c.c. being this time driven over. In this distillate the ammonia is estimated by Nessler's test. We have found that, not unfrequently, the colour produced in this distillate by the Nessler test is canary yellow, instead of brownish, as in the case of ammonia. This is perhaps owing to the presence of some of the compound ammonias.

To the contents of the flask are now added 2 grms. of pure permanganate of potassium and 10 grms. of hydrate of potash, previously dissolved in about 100 c.c. of distilled water and boiled for some time, so as to avoid all chance of contamination with ammonia. Some pieces of freshly ignited tobacco pipe are put into the flask to avoid bumping. From 500 to 600 c.c. of fluid are distilled over and separately collected. In this distillate the ammonia is also estimated by Nessler's test, or by careful titration with $\frac{1}{50}$ normal acid. The amount thus found, multiplied by ten, gives the quantity of albuminous matter in the 10 c.c. wine taken, and multiplied by 100 gives the per cent. of the albuminous matter in the wine.

We have convinced ourselves, by careful experiments, that the above process gives constant results when applied to one and the same wine.

In the following tables we give some of the analytical results obtained by the above processes:—

Ammonia—

Rauenthaler (1862)	0·0038 per cent.	Natural sherry	0·0010 per cent.
Do. (1864)	0·0799 ,,	Do. (1850)	0·0012 ,,
Hattenheimer (1862)	0·0039 ,,	Cape port	none.
Hungarian	0·0029 ,,	Cape sherry	none.
Natural sherry	0·0007 ,,	Do.	0·0005 per cent.

Albuminous matters estimated by the addition of strong chlorine water to the wine—

Kiedericher	slight trace.	Graefenberger	none.
Selzener	0·0278 per cent.	Erbacher	slight trace.
Jugenheimer	0·0160 ,,	Bodenheimer	0·0200 per cent.
Hardt wine	0·0184 ,,	Hattenheimer	0·0096 ,,
Dromersheimer	0·0180 ,,	Rauenthaler	0·0020 ,,

The above ten wines were from the vintage 1865, and were examined in the middle of August 1866. All were slightly turbid. Nos. 1, 5, 6, 7, 9, and 10, were effervescing. In the next fifteen wines the precipitate produced by the chlorine was not collected, but its amount was simply judged of by the eye.

Light claret	traces.
St. Elie	strong precipitate.
Red Keffesia	do. do.
Santorin	do. do.
Lachryma Christi	do. do.
Natural sherry	none.
Do. do.	do.
Do. do.	do.
Sherry	none.
Do.	traces.
Elbe sherry	none.
Cape port	strong traces.
Do.	slight traces.
Marsala	very slight traces.
Do.	none.

Ammonia and albuminous matters estimated by Wanklyn and Chapman's process :—

	Albuminous matters.	Ammonia.
Ingelheimer (red)	0·3750 per cent.	0·0051 per cent.
Port (1851)	0·0888 ,,	0·0046 ,,
Sherry (50 years in bottle)	0·1807 ,,	0·0073 ,,
Madeira (50 years in bottle)	0·1581 ,,	0·0021 ,,
Niersteiner[1]—		
Before heating	0·3550 ,,	0·0021 ,,
After heating	0·2448 ,,	0·0022 ,,
Natural port	0·0527 ,,	0·0019 ,,
Port (1865)	0·1760 ,,	0·0012 ,,

TANNIN.

Many plants contain astringent principles, which give precipitates with solutions of gelatine and albumen, and produce a deep bluish-black precipitate or coloration with persalts of iron. The most widely diffused, and the best known of these substances, is the tannin extracted from galls; and hence all analogous substances have received the same name, with the addition of surnames signalizing the plants from which they are derived. They are all glucosides; that is, bodies which, when acted upon by suitable agents, absorb water and break up into two new compounds, one of which is glucose.

1 This wine had become slightly effervescent in bottle, and some bottles of it were heated for some time to 70° C., according to Pasteur's plan for the preservation of wine.

They are all characterized by their strong affinity for albuminous substances, with which they form combinations very little liable to putrefaction; hence their use for tanning.

The juice of most grapes is perfectly free from tannin; the skins and stalks, however, contain a considerable quantity of a substance which, though not ordinary tannin, closely resembles it in properties. For ordinary tannin, when heated with dilute sulphuric acid, breaks up into glucose and gallic acid; it suffers the same change when exposed, in solution, to atmospheric air. The tannin of grapes, under the like circumstances, breaks up into glucose, and an acid which is not gallic acid.

White wines, in the preparation of which the must is at once separated from the murk, contain little tannin; while red wines, being allowed to ferment with the murk, are rich in tannin, which imparts to them the well-known astringent taste. The tannin of white wines is sometimes derived from the oaken casks in which the wine is kept; their colour, at first very pale yellow, increases in depth in the course of years. The tannin contained in them absorbs oxygen and is converted into a yellow, or brown, humus-like substance, which, though much less soluble in wine than the tannin, is yet sufficiently so to impart a strong colour to it. Red wines, on the other hand, gradually lose their dark colour by the agency of the tannin they contain. In these wines so much tannin is present that more of the humus-like substance is gradually formed than can remain dissolved; it is thus thrown down as a precipitate, and carries the colouring matter with it.

The presence of tannin in white wines may be detected by the inky coloration produced on the addition of a persalt of iron and acetate of potash. The latter reagent has to be added, because in the presence of free tartaric or malic acid persalts of iron do not readily yield the black coloration with tannin; the presence of acetic acid has much less influence. Hence, if to a solution containing free tartaric or malic acid we add a slight excess of acetate of potassium, tartrate or malate of potassium is produced, and free acetic acid only remains, which will not interfere with the iron test. The depth of colour produced gives at the same time some indication of the amount of tannin present. The precipitate produced by a solution of gelatine in white and red wines may be collected and weighed, and will also give an idea of the quantity of tannin present.

Tannin reduces copper salts like glucose, 3·5 parts of tannin having the same effect as five parts of glucose. Nessler has made use of this property for the approximate estimation of the amount of tannin found in wines. He first estimates the amount of copper solution reduced by the wine itself, then shakes the wine with animal charcoal, and again measures its effect on the copper test. The animal charcoal removes the tannin, and the second experiment will show less reducing action than the first. But, as Nessler himself has pointed out, there are other substances contained in wine beside the tannin, which reduce copper-salts, and are removed from solution by animal charcoal. The process, therefore, shows too much tannin.

As tannin exerts a preservative action on albuminous substances, it is supposed to render red wines durable in spite of the greater amount of albuminous substances they contain. The addition of tannin to wines liable to turn has also, on this account, frequently been proposed, and seems to act beneficially. It would, however, be advisable to use for this addition a tannin extracted from the skins, stalks, or kernels of the grape itself, instead of the ordinary tannin extracted from gall-nuts.

EXTRACTIVES.

If we subtract from the total solid constituents of wine all those admitting of accurate estimation, such as the fixed acids, sugar, some compound ethers, mineral constituents, and perhaps the glycerine, there remains a certain amount of matter, with the exact chemical characters of which we are at present unacquainted. These substances are termed extractives or extractive matters. They are never absent from, but on the contrary generally constitute the greater part of, the total solids in all genuine wines, which contain little or no sugar. In all sweet wines, however, containing much sugar, the greater part of the solids is sugar. On the other hand, many adulterated or factitious wines contain little or nothing of these extractives, and it is, therefore, frequently of some importance to be able accurately to estimate the total solids, for the purpose of distinguishing the genuine from the factitious article. In genuine wines also the extractive matter frequently stands in some relation to the value of the wine, the higher class wines containing generally more extractive than the lower kinds. In this respect, however, wines of the same origin and kind only can be compared: thus Rhine wines with Rhine wines, Bordeaux with Bordeaux, &c. When thus limited the rule frequently holds good, but is totally inapplicable to the comparison of different sorts of wine.

MINERAL CONSTITUENTS.

If the dry residue of a wine is subjected for some time to a dull red heat, the organic ingredients are consumed, and the incombustible or mineral constituents remain behind in the form of ash. This ash consists chiefly of potassic carbonate, chloride, sulphate, and phosphate, sodic chloride, and calcic phosphate, and carbonate, with traces of magnesia, iron, silica, and sometimes of alumina and manganese. Potassic and calcic carbonates are not as such contained in the wine, but are produced by the combustion of the tartrate or malate of potassium or calcium. From the ash of pure natural wines, carbonates and chlorides are scarcely ever absent; sometimes, however, if the wine has been subjected to much sulphuring, it may contain an excess of sulphuric acid, which, during the evaporation and incineration, drives out all the volatile acids; the ash, in such a case, consists exclusively of sulphates and phosphates. The ash of wines made from must, to which plaster of Paris had been added, scarcely ever contains carbonates, and is very frequently free from chlorides, on account of its containing an excess of sulphuric acid formed by double decomposition from the calcic sulphate and potassic bitartrate.

ESTIMATION OF ASH.

20 c. c. wine are measured into a small shallow porcelain or platinum crucible, and evaporated on a water-bath; the residue is dried in an air-bath at 120° C., and upwards; and finally, for some time, heated to a dull red heat over a gas-burner, or in a muffle, until the combustible part is burned off and a white or slightly grey ash is left. The crucible is then allowed to cool under a desiccator and weighed. The weight found multiplied by five gives the per cent. of ash. In thus incinerating the dry residue of a wine, too great a heat must be avoided, otherwise some of the salts present will fuse, and by enclosing the carbon prevent its complete combustion. If this has, nevertheless, happened, the imperfectly burned ash should be extracted with distilled water, the residual carbon burnt, and the slight amount of ash it leaves weighed. The aqueous extract of the ash is evaporated, ignited, and also weighed, and the two portions thus found are added together. The amount and nature of the ash left by a wine is a very valuable means for judging of its genuineness, and its examination should therefore never be neglected.

ANALYSIS OF ASH.

The ash, after having been weighed, is extracted with water, and the insoluble portion, consisting chiefly of calcic phosphate, is filtered off, washed, ignited, and weighed. In the aqueous solution the alkalinity is determined by a standard solution of decinormal sulphuric acid; or, better, a slight excess of decinormal acid is added (2 or 3 c. c. of acid are generally sufficient), the mixture boiled, and the excess of acid is then estimated by a decinormal solution of soda. In order to be able to ascertain the point of neutrality some tincture of logwood is added, which changes from yellow, in the acid, to brown and pink in the neutral and alkaline solution as previously described. After this the phosphoric acid in combination with potash or soda may be estimated in the same solution in the following manner:—A few drops of acetic acid and acetate of potassium having been added, the solution is heated to boiling, and a standard solution of uranic nitrate or acetate is dropped in from a burette divided into tenths of c. c. until a slight excess of uranium has been added, when the amount of standard solution used gives at once a measure of the phosphoric acid present. The point where sufficient uranium has been added is determined as follows:—As long as any appreciable quantity of phosphoric acid is in solution, each drop of uranic nitrate added will produce a pale yellow precipitate of uranic phosphate, not a trace of uranium remaining dissolved. As soon, however, as all phosphoric acid has been precipitated, any further quantity of uranic nitrate added remains in solution, and can be readily detected by ferrocyanide of potassium. For this purpose a number of drops of ferrocyanide are put upon a white slab of porcelain; and as soon as the production of a precipitate, by the addition of the uranic nitrate, can no longer be observed, a drop of the mixture is taken out and added to one of the drops of ferrocyanide on the slab; the slightest excess of uranium is then indicated by the production of a brown coloration where the two drops mingle. If no brown colour is produced, a further quantity of uranic nitrate is carefully added, and again a drop tested, and so on, until the brown colour is observed; the mixture should, during the experiment, be kept near its boiling-point. Iron and alumina, which would necessitate a modification of the process, are never contained in wine in sufficient quantity to interfere sensibly with its accuracy. For the successful working of this process it is, however, essential that the only free acid present should be acetic acid, and that, at the same time, no large amount of an acetate should be present: the first, because uranic phosphate is soluble in other acids; the second, because the presence of much acetate prevents the production of the brown coloration with ferrocyanides.

If, then, the solution to be tested is acid, the acid not being acetic, it is necessary to neutralize it nearly with ammonia, and then add only just enough sodic acetate to neutralize the remaining free mineral acid; or preferably to render it slightly alkaline by ammonia, gently heat for some time to expel nearly all the excess of ammonia, and then acidify again by a few drops of acetic acid. Should the solution be neutral, a few drops of acetic acid are added; if alkaline, the alkalinity is nearly neutralized by hydrochloric or nitric acid, and finally a small excess of acetic acid is added. If these precautions are adopted, the process yields very accurate results. A convenient strength of the uranic solution is such that 1 c. c. of it indicates 0·005 grm. phosphoric acid; the strength must be fixed by titration with pure sodic phosphate.

The part which was insoluble in water is (after having been weighed) dissolved in a little hydrochloric acid; the solution is neutralized with ammonia, acidified with acetic acid, and the phosphoric acid estimated as above. The quantity thus found, calculated as calcic phosphate and subtracted from the total insoluble part, leaves the calcic carbonate. The salts thus estimated, namely, potassic carbonate and phosphate, and calcic carbonate and phosphate, when subtracted from the total ash found, leave the potassic and sodic sulphate and chloride. Small traces of other substances may be neglected. Chlorides are frequently absent from the ash, but should always be searched for. If it is desired to estimate sulphuric acid and chlorine, two portions of the ash are dissolved in nitric acid, and in one the chlorine is precipitated by nitrate of silver, in the other the sulphuric acid by chloride of baryum; the resulting precipitates are collected on filters, dried, ignited, and weighed with the usual precautions. 100 parts of chloride of silver contain 24·73 parts of chlorine, and 100 parts of baryum sulphate correspond to 42·49 parts of sulphuric acid. Potassium and sodium must also be estimated in a separate portion as follows:—The ash from 20 c. c. wine is boiled with water, and a slight excess of baryum chloride and hydrate added to the boiling solution. The precipitate produced is filtered off; to the filtrate an excess of ammonium carbonate added; the mixture is boiled, and once more filtered: both precipitates are well washed with boiling water. The second filtrate is then evaporated to dryness, and the residue ignited and weighed; it consists of the chlorides of potassium and sodium. The mixed chlorides are dissolved in water, to which platinic bichloride is added, and the whole evaporated to dryness on a water-bath. The dry residue in the dish is extracted with spirit of about 80 per cent. strength, and the insoluble double chloride of platinum and potassium, after having been several times washed by decantation with the spirit, is collected on a weighed filter, dried at 100° C. and weighed. 100 parts of the double chloride contain 28·16 parts of potassic chloride; the amount of potassic chloride thus found, subtracted from the mixed chlorides, leaves the sodic chloride. 100 parts of potassic chloride contain 52·34 parts of potassium; 100 parts of sodic chloride, 39·31 parts of sodium. Should the first part of the spirit, with which the above double chloride of potassium and platinum is washed, not be decidedly yellow, more platinic bichloride must be added, and the mixture again evaporated to dryness. In pure wines potassium is always the predominating alkali metal.

As stated above, chlorides are not unfrequently absent from the ash of wine; they are, however, always present in the wine, and therefore, if it is desired that the amount of chlorine present be estimated, it must be done in the wine itself. For this purpose from 20 c. c. to 50 c. c. of the wine are acidulated with nitric acid, an excess of nitrate of silver is added, and after twelve hours' standing the precipitated chloride of silver is collected, washed, ignited, and weighed. The ignition should be done in a porcelain crucible, the filter burnt separately, and the ash added to the chloride; it is also advisable to add a drop or two of strong nitric acid to the ignited chloride and filter ash, and then a few drops of hydrochloric acid, and to again dry, ignite, and weigh the contents of the crucible. The fact that the ash of some wines contains no chlorides, or a diminished amount of chlorides, while the wine contained notable quantities of chlorides, is sometimes due to the presence of sulphuric acid, which, during evaporation, expels the hydrochloric acid; some part of the hydrochloric acid is, however, always lost during evaporation, being expelled by the great excess of tartaric and malic acids present, and the amount of chlorides found in the ash is therefore never a correct measure of the hydrochloric acid in the wine itself. In the majority of cases the sulphuric acid found in the ash is the total quantity present in the wine: this is always the case if the ash contains either carbonates or chlorides; sometimes, however, there is more sulphuric acid in the wine than can be neutralized by the bases present, and in such a case part of it is lost during ignition; the ash, in such cases, is free from carbonates and chlorides. This is sometimes the case with wines which have been impregnated with sulphurous acid by burning sulphur in the cask. More frequently, however, this excess of sulphuric acid comes into the wine through the practice of adding plaster of Paris to the must, which is general in all southern countries. In such a case it is necessary to estimate the sulphuric acid in the wine itself. This is done as follows:—

From 20 c. c. to 50 c. c. of the wine are acidulated with hydrochloric acid heated nearly to boiling, and mixed with a slight excess of baryum chloride; after standing for twelve or twenty-four hours, the resulting baryum sulphate is washed with hot water, first by decantation, then on a filter on which it is carefully collected; the filter is then dried, ignited, and the baryum sulphate weighed, the amount of ash left by the filter itself being subtracted. 100 parts of baryum sulphate correspond to 42·49 parts of sulphuric acid.

The other mineral constituents are generally present in minute traces only. In the presence of iron the hydrochloric acid solution of the ash gives a blue precipitate with ferrocyanide, or a blood-red coloration with sulphocyanide of potassium. Manganese is generally detected by the green colour it imparts to the ash; the colour comes out much more distinctly by fusing the ash with sodic carbonate and a little potassic nitrate. Silica is detected by dissolving the ash in hydrochloric acid, evaporating to dryness, and again taking up in hydrochloric acid; an insoluble gritty or sandy residue is silica. Alumina is rarely present in any quantity; if present, it may be detected as follows:—The hydrochloric solution from which the silica has been separated is precipitated with an excess of potassic hydrate; the resulting precipitate of calcic phosphate is filtered off, the filtrate acidified with hydrochloric acid and again neutralized with ammonia: a precipitate is alumina or phosphate of alumina. Sometimes, however, a trace of calcic phosphate is dissolved by the potash, and this, being precipitated by the ammonia, may be mistaken for alumina. It is, therefore, better to acidify the potash solution slightly with acetic acid, and to precipitate any lime present with oxalate of ammonia; after allowing the solution to stand for some time, the precipitated calcic oxalate is filtered off, and ammonia added to the filtrate: the precipitate produced is alumina or phosphate of alumina. (Alum is said to be sometimes added to red wine, in order to heighten its colour.)

The amount of ash varies considerably in different classes of wines: in pure natural wines it amounts generally to from 0·15 to 0·30 per cent.; in wines which have been plastered the ash rises to 0·5 per cent. and upwards; and in all wines in which the excessive acidity has been neutralized by an alkali the ash may rise considerably above this amount. The tables appended will give a fair indication of the amount of ash found in the different classes of wines which have not been subjected to adulteration.

TOTAL SOLID CONSTITUENTS.

Two methods are employed for the purpose of estimating the total solids: in the one most generally in use the solids are estimated directly; in the other, indirectly.

First Method.—20 c. c. of wine (or if the wine leaves much residue, only 10 c. c.) are measured by means of a pipette, and poured into a small platinum or porcelain evaporating dish, or shallow crucible of known weight. The wine is then evaporated on an open water-bath, and the residue finally dried at a temperature of 110° to 115° C. in an air-bath. The drying should be continued until the residue ceases to lose weight when kept for three or four hours at the above temperature. The time required for this is about twenty-four hours. The drying may be somewhat

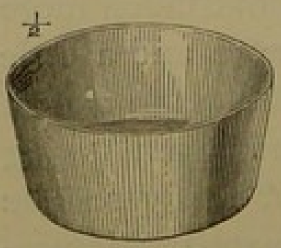


FIG. 48.—Flat porcelain crucible for evaporating the 20 c. c. of wine.

facilitated by placing the capsule holding the extract on a sand-bath heated to about 110° C., and bringing the whole under the receiver of an air-pump, in which there is also a dish holding sulphuric acid, and exhausting. The weight of the residue found multiplied by five (or ten) gives the total solid constituents of the wine. Although this process is usually looked upon as the most accurate, we have not found this to be the case. It rests upon the assumption that the solid constituents of the wine may be dried at a temperature sufficient to expel all the water and yet suffer no alteration themselves, and the temperature of 110° or 115° is supposed to answer this purpose. Careful experiments, however, have shown us that the complicated mixture of substances, constituting the solid residue left on evaporation, cannot be dried even at a temperature of 100° C. without suffering decomposition. This is proved by the great diminution of the free fixed acid after the weight of the residue is found to be constant in two successive weighings separated by an interval of several hours' drying, and by the fact that only part of the residue is soluble in water after the drying is completed, while originally the whole was readily soluble. Such drying in a steam or hot-water oven, moreover, takes a very long time, sometimes an entire week. After drying at 110° or 115°, the decomposition of some part of the residue is still more manifest. The free fixed acid has almost entirely disappeared, and only a small part of the residue remains soluble in water; the greater part consists of a dark brown, semi-charred mass. In wines containing not too much extract, better results might, no doubt, be obtained, if the residue were heated during not more than three or four hours to a temperature of 100° or 105°, without continuing the drying till the weight remains constant. With wine having much extractive, there would, however, be great danger of over-estimating the total solids.

It is then evident that the substance obtained by evaporating and drying the residue, at 100° or 115°, cannot be taken as representing the solids of the wine. If the drying has not been carried far enough, the residue will still contain water;

whilst if all the water be expelled, at 100° to 115°, the residue will have suffered so much decomposition as to be almost valueless for a quantitative estimation. Our analyses will show that, in a number of instances of wines rich in sugar, the total amount of solids found by this method falls below the amount of sugar contained in them, and thus clearly exhibit the inaccuracy of the method.

Second Method.—In the chapter on the chemistry of alcohol we have minutely described Tabarie's method, in which the alcoholic strength of a wine is calculated from the difference between the specific gravity of the wine and that of the liquid which remains after its alcohol has been expelled, and the original bulk restored by distilled water. If the composition of the solid residue were always the same, and if we could by careful experiments fix the relation existing between the amount of such matter present in an aqueous solution and the specific gravity of the solution, nothing of course would be more simple than finding the amount of the solid constituents of a wine by means of the specific gravity of the dealcoholized liquid. Unfortunately, as has been shown above, it is not possible to obtain the solid constituents of a wine at once dry and otherwise unaltered; and it is, therefore, impossible to carry out the required experiments regarding the relation between the amount of substance in solution and its specific gravity.

Balling has, however, instituted a very careful inquiry into this relation in regard to beer-wort, and has shown that the specific gravity of solutions of malt extract is the same as that of solutions of pure cane-sugar, if both contain the same amount of substance in solution. We may, therefore, substitute one for the other without appreciable error. Now, extract of malt and extract of wine are sufficiently similar to each other to justify us in assuming that no great error will be committed by taking the specific gravities of their solutions to be the same for equal percentages of extract. In other words, we may use the tables showing the percentage of sugar in solutions of different specific gravities, for the estimation of wine extract. Only the mineral constituents of the wine, *i.e.* those left in the ash, differ materially from sugar as regards the specific gravity of their solutions ; for a given specific gravity they contain about twice as much substance in solution as a sugar solution of the same gravity. In estimating, therefore, the total solid constituents of a wine by the specific gravity of the dealcoholized wine, it is necessary to subtract from the percentage of extract thus estimated the percentage of ash found in the same wine ; or, if the amount of extract without the ash is required, twice the percentage of ash has to be subtracted from the percentage found, according to the specific gravity. In wines containing but little ash, this correction is not very important ; but as in some wines the ash amounts to 0·5 per cent. and upwards, a serious error would be committed without it.

In our tabulated analyses we give for nearly each wine the amount of total solid organic residue, the ash being in each case deducted, as estimated by both the above methods. With one exception, most likely occasioned by insufficient drying of the residue, the amount of extract found by the second method is larger than that found by the first : this, however, is as it should be, for the extract found by the second method includes not only the glycerine, driven off during the drying, but the residue, when heated sufficiently long to expel all the moisture, suffers a considerable amount of decomposition besides, in consequence of which small quantities of matter are volatilized. That the second method has a greater claim to accuracy than the first, may also be seen on reference to wines containing a considerable amount of sugar. In such cases the first method often gives less total solids than the wine contains sugar.

Thus in Marsala, the total dry residue, *minus* ash, found by first method was	4·132	per cent.
Second method	5·780	,,
The sugar amounting to	4·7	,,
In Spanish Port extract, *minus* ash, found by first method	4·632	,,
Second method	6·909	,,
The sugar amounting to	5·26	,,
And again in Lachryma Christi (Greek) extract, *minus* ash, found by first method	24·262	,,
Second method	32·022	,,
The sugar amounting to	26·784	,,

The same will be found in several other instances, while in a still greater number the sugar and fixed acid together amount to more than the total solids found, leaving no margin at all for any of the other substances. The amounts found by the second method, after all such substances have been subtracted which admit of ready estimation, leave in all cases a small excess, which may be accounted for by the glycerine and extractive matters. The first method, then, is in many instances clearly and demonstrably inaccurate, and we may safely assume that it is so in all.

The second method has another great advantage over the other; it can be performed in less than one-tenth the time, even if all the necessary weighing and evaporation are performed merely with the view of estimating the extract; whilst if Tabarie's plan of estimating the alcohol be adopted, the amount of extract is obtained by merely looking in the table for the amount of sugar corresponding to the specific gravity of the dealcoholized wine, and subtracting from the amount of extract thus indicated the percentage of ash previously estimated. It appears, then, to be in most cases waste of time and trouble to estimate the solid constituents of a wine by evaporating a given quantity and drying, and weighing the residue left.

We may, in conclusion, give two examples.

RAUENTHALER, 1859. (£15 OHM.)

Specific gravity of dealcoholized wine	1008·101
Percentage of sugar corresponding to this . . .	2·041
Percentage of ash found	0·170
Total solid constituents	1·871
To find total solids, *minus* ash, subtract again . .	0·170
Leaves total solids, *minus* ash	1·701 per cent.

SHERRY, 1865.

Specific gravity of dealcoholized wine	1017·56
Percentage of sugar corresponding to this . . .	4·467
Percentage of ash found	0·515
Total solids	3·952
Subtract ash	0·515
Total solids, *minus* ash	3·437 per cent.

INSTRUMENTS AND CHEMICAL REAGENTS NECESSARY FOR THE PERFORMANCE OF AN ANALYSIS OF WINE.

Instruments.—Pipettes to deliver 25, 20, 10, 5, 3, and 1 c.c.; pipette holding 20 c. c. graduated into tenths; two burettes holding 50 c. c. divided into tenths, and one holding 25 c. c. also divided into tenths. Measuring flask, with mark on the neck of the flask, holding 500, 250, 200, 100, and 50 c. c. A number of flat porcelain crucibles, holding from 25 to 30 c. c.; two platinum crucibles. Porcelain evaporating dishes to hold 100 and 150 c. c. Beakers of thin glass, flasks, glass rods, assay flasks (large and small); wash bottle; wide-mouthed stoppered bottles, holding 150 to 200 c. c.; one large ditto holding two bottles of wine. Various stills, in one of which at least the tube of the condenser should be of glass. Centigrade thermometer, Argand burners, Bunsen burners, wire triangles, crucible tongs, desiccator, air-bath with thermometer, retort stands, stands for burettes, platinum wire, various-sized funnels, filtering-paper, white porcelain slabs. Water-baths of several sizes, with covers, having holes to suit the different sizes of crucibles and evaporating dishes. Specific gravity bottle with thermometer, holding from 25 to 50 c. c. A delicate chemical balance, delicate saccharometer (best a Jellett's). Small sand-bath. Spectroscope. For the preparation of the various standard solutions, mixing cylinders, holding from one to two litres, and graduated from 10 to 10 c. c.

Standard solutions.—Decinormal solution of potash or soda; decinormal sulphuric acid; decinormal alcoholic solution of potash; uranium nitrate; copper sulphate.

For prescriptions regulating the preparation of these solutions we must refer the reader to works on volumetric analysis.

Reagents.—Testing solutions of chloride of baryum, nitrate of silver, perchloride of iron, acetate of potassium, caustic potash, caustic baryta, carbonate of ammonium, ferrocyanide of potassium, acetate of lead, bichloride of platinum, may be prepared by dissolving one part of the solid substances in from ten to twenty parts of water; ammonia, sulphuric acid, nitric acid, hydrochloric acid, by mixing one part of the strongest acid or ammonia with three parts of water. Solution of bichromate of potassium and sulphuric acid: 147 parts of bichromate, 220 parts of strong sulphuric acid made up to 1400 c. c. solution. Caustic potash, permanganate of potassium, carbonate of baryum, granulated zinc, animal charcoal, carbonate of sodium, tannin. Alcohol, ether, tincture of logwood, solution of litmus, red and blue test papers, distilled water.

SYLLABUS OF ANALYSIS.

All the necessary apparatus, tests, &c. being ready and in good order,—

1. Heat the water-baths to boiling, put on two platinum and two porcelain crucibles, one evaporating dish of 400 c. c. and one of 150 c. c. capacity.

2. Take two bottles of the wine to be analysed, mix in large bottle, shake to expel carbonic acid, take temperature, bring temperature to about 15°5. It is not, however, advisable to work with the wine at a temperature below the temperature of the room.

3. Measure with pipette 20 c. c. wine into each of the following vessels: two porcelain and two platinum crucibles, three beakers (Nos. 1, 2, and 3), and two wide-mouthed stoppered bottles (*a* and *b*). These quantities are to serve for the determination of the fixed acid, total residue, ash (two), total acid, chlorine, sulphuric acid, bitartrate of potassium, total tartaric acid.

4. Measure with flasks 100 c. c. and 250 c. c. into the above evaporating dishes on water-bath (dealcoholized wine and fixed ether).

5. Measure 250 c. c. wine into still, add tannin and potash, heat and collect distillate (alcoholic strength).

6. While distillation, &c. is going on, take specific gravity of wine, estimate total acidity (beaker No. 1), take beaker No. 2 and No. 3, precipitate chlorine and sulphuric acid,

set aside; precipitate tartar and total tartaric acid in bottles (*a* and *b*), set aside.

7. When distillation is finished, make up distillate to 250 c. c., at original temperature of wine; clean out still, and set 250 c. c. fresh wine distilling, without any addition (volatile ethers); take specific gravity of first distillate.

8. When the contents of the four crucibles have been heated sufficiently long on water-bath, place one of the porcelain crucibles into air-bath heated to 110° C., till weight remains constant (total dry residue); estimate acidity of the residue in another of the porcelain crucibles (fixed acids); heat the two platinum crucibles to dull red heat, on Argand burner or in muffle, till ash is white; weigh ash in one crucible, and use it for estimating alkalinity, for determining the portion insoluble in water, and the phosphoric acid in this insoluble portion; the ash in the other crucible, which need not for this purpose be burnt perfectly, use for estimating total phosphoric acid.

9. When the 100 c. c. in small dish have evaporated to about 40 c. c., transfer to 100 c. c. flask, cool and fill up to 100 c. c. with distilled water at original temperature; take specific gravity of this dealcoholized wine (used for calculating total residue and alcoholic strength).

10. When 250 c. c. in large dish are evaporated to about 40 c. c., transfer to small still, render alkaline, &c. (fixed ethers).

11. Take 100 c. c. wine, add 10 to 20 c. c. acetate of lead solution according to colour, shake and filter through dry filter, shake up with animal charcoal, filter; estimate amount of circular polarization in this filtrate (with very sweet wines less than 100 c. c. may be taken).

12. Dilute filtrate (11) to the necessary extent (see paragraph on Saccharometry, p. 227), and estimate sugar in filtrate by copper test.

13. After twenty-four hours' standing collect precipitates of chloride of silver and sulphate of baryum, from beakers 2 and 3; wash, dry, ignite, and weigh (total chlorine and sulphuric acid).

14. After forty-eight hours' standing, collect precipitates in bottles (*a* and *b*), wash with ether alcohol, and estimate acidity with decinormal soda (bitartrate of potassium and total tartaric acid).

For necessary calculations and details see special chapters. A complete analysis, according to the foregoing programme, occupies several days. If a less complete analysis is sufficient, time and trouble may of course be saved: but it will always be well to keep in mind the following rule, viz., first, get all implements and reagents ready; and next, set all those processes going which take the longest time for their completion, during the greater part of which, however, they do not require much attention.

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES.

1	2	3	4	5	6	7
Progressive Number.	NAME.	Colour.	Year.	Price.	Specific Gravity of Wine.	Specific Gravity of Wine, *minus* Alcohol.
	GERMAN WINES—					
1	Leisten Riessling . . .	White	1858	60*s*. per doz.	992·31	1010·04
2	Do. do.	,,	1859	£37 per ohm.	993·95	1009·55
3	Do. do. . . .	,,	1862	19 10*s*. ,,	992·29	1009·09
4	Rauenthaler	,,	1859	15 ,,	993·48	1008·10
5	Do.	,,	1862	24 ,,	994·01	1008·17
6	Do.	,,	1862	30 ,,	983·84	1010·34
7	Do.	,,	1864	6 ,,	997·32	1009·55
8	Do.	,,	1865	24 ,,	991·26	1007·76
9	Ungsteiner	,,	1862	8 ,,	993·35	1007·81
10	Do.	,,	1862	12 ,,	992·82	1007·90
11	Hattenheimer	,,	1862	40 ,,	993·26	1009·96
12	Do.	,,	1865	18 ,,	991·60	1008·14
13	Do.	,,	1862	15 ,,	994·19	1009·76
14	Steinberger Cabinet . .	,,	1857	60 ,,	992·81	1008·82
15	Do. do. . . .	,,	1857	50 ,,	993·22	1009·07
16	Forster Traminer Auslese	,,	1862	24 ,,	992·60	1009·27
17	Forster Traminer . .	,,	1862	18 ,,	992·14	1008·57
18	Bodenheimer	,,	1862	10 ,,	993·42	1008·23
19	Do.	,,	1865	12 ,,	993·48	1011·58
20	Marcobrunner Auslese .	,,	1862	45 ,,	994·82	1011·07
21	Essenheimer	,,	1862	7 ,,	994·36	1007·45
22	Oestricher	,,	1862	36 ,,	992·77	1009·36
23	Niersteiner	,,		5 10*s*. ,,	995·63	1008·21
24	Stein Riessling . . .	,,	1858	45 ,,	991·73	1008·94
25	Dromersheimer . . .	,,	1865	9 ,,	994·69	1011·76
26	Erbacher	,,	1865	15 ,,	994·01	1010·79
27	Graefenberger . . .	,,	1865	20 ,,	996·06	1012·44
28	Hardt Wine	,,	1865	7 ,,	992·30	1007·76
29	Jugenheimer	,,	1865	8 ,,	995·14	1011·24
30	Kiedricher	,,	1865	14 ,,	993·37	1010·58
31	Seltzener	,,	1865	10 ,,	996·37	1014·58
32	Grünhäuser	,,	1862	18 ,,	992·54	1008·60
33	Ingelheimer	Red	1862	10 ,,	996·60	1010·97
34	Zeltinger	White	1862	13 ,,	1000·24	1013·81
35	Dom Scharzhofberger .	,,	1862	30 ,,	993·13	1008·29
	FRENCH WINES—					
36	Light Claret	Red	—	15*s*. per doz.	995·58	1009·39
37	Do. do.	,,	—	12*s*. ,,	994·48	1008·14
38	Claret	,,	—	12*s*. ,,	994·72	1008·91
39	Do.	,,	—	15*s*. ,,	995·00	1009·38
40	Do.	,,	—	30*s*. ,,	995·08	1008·87
41	Do.	,,	—	66*s*. ,,	994·73	1008·02

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	8	9	10	11	12	13
Progressive Number.	NAME.	Specific Gravity of Distillate.		Percentage of Alcohol by weight in volume.		Difference between Cols. 10 and 11.	Strength of Wine in degrees of Proof Spirit.
		Found.	Calculated.	According to Col. 8.	According to Col. 9.		
	GERMAN WINES—						
1	Leisten Riessling	981·95	982·27	11·43	11·21	—·22	25·2
2	Do. do.	983·92	984·39	9·82	9·45	—·37	22·0
3	Do. do.	983·08	983·20	10·55	10·45	—·10	23·4
4	Rauenthaler	984·99	985·38	9·06	8·77	—·29	20·0
5	Do.	985·49	985·84	8·70	8·47	—·23	19·2
6	Do.	983·02	983·50	10·60	10·17	—·43	23·5
7	Do.	987·49	987·77	7·35	7·17	—·18	16·2
8	Do.	982·93	983·50	10·69	10·17	—·52	23·6
9	Ungsteiner	985·17	985·54	9·03	8·68	—·35	19·7
10	Do.	984·46	984·92	9·44	9·13	—·31	20·9
11	Hattenheimer	983·04	983·30	10·58	10·36	—·22	23·5
12	Do.	982·97	983·46	10·65	10·22	—·43	23·6
13	Do.	983·93	984·43	9·81	9·46	—·35	22·0
14	Steinberger Cabinet	983·41	983·98	10·26	9·78	—·48	22·9
15	Do. do.	984·26	984·15	9·59	9·65	+·06	21·1
16	Forster Traminer Auslese	983·00	983·33	10·62	10·36	—·26	23·5
17	Forster Traminer	983·30	983·57	10·36	10·12	—·24	23·0
18	Bodenheimer	984·49	985·19	9·41	8·91	—·50	20·8
19	Do.	981·36	981·90	11·88	11·47	—·41	26·3
20	Marcobrunner Auslese	983·17	983·75	10·48	9·96	—·52	23·2
21	Essenheimer	986·18	986·88	8·24	7·78	—·46	18·2
22	Oestricher	982·59	983·41	10·82	10·25	—·57	24·2
23	Niersteiner	987·07	987·42	7·63	7·40	—·23	16·8
24	Stein Riessling	982·35	982·78	11·15	10·83	—·32	24·8
25	Dromersheimer	983·42	982·93	10·24	10·72	+·48	22·9
26	Erbacher	982·87	983·22	10·74	10·43	—·31	23·7
27	Graefenberger	983·21	983·62	10·44	10·08	—·36	23·2
28	Hardt Wine	984·72	984·54	9·27	9·38	+·11	20·4
29	Jugenheimer	983·37	983·90	10·29	9·83	—·46	23·0
30	Kiedricher	982·71	983·39	10·87	10·25	—·62	24·1
31	Selzener	981·50	981·79	11·77	11·56	—·21	26·0
32	Grünhäuser	983·50	983·93	10·17	9·80	—·37	22·7
33	Ingelheimer	985·26	985·63	8·89	8·63	—·26	19·5
34	Zeltinger	986·39	986·43	8·09	8·07	—·02	17·8
35	Dom Scharzhofberger	984·26	984·85	9·58	9·17	—·41	21·1
	FRENCH WINES—						
36	Light Claret	985·93	986·19	8·41	8·21	—·20	18·6
37	Do. do.	—	986·34	—	8·13	—	18·0
38	Claret	985·23	985·81	8·89	8·50	—·39	19·6
39	Do.	985·20	985·60	8·92	8·65	—·27	19·6
40	Do.	985·67	986·20	8·59	8·22	—·37	18·9
41	Do.	985·93	986·71	8·41	7·88	—·53	18·6

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1 Progressive Number.	2 NAME.	14 Free fixed Acid, calculated as Tartaric Acid.	15 Free volatile Acid, calculated as Acetic Acid.	16 Total free Acid, calculated as Tartaric Acid.	17 Real Tartaric Acid.
	GERMAN WINES—				
1	Leisten Riessling	·480	·124	·635	·0975
2	Do. do.	·438	·135	·607	·0675
3	Do. do.	·420	·096	·540	·1312
4	Rauenthaler	·420	·114	·562	·2550
5	Do.	·445	·178	·572	·0596
6	Do.	·453	·138	·626	·1387
7	Do.	·675	·118	·823	·1473
8	Do.	·276	·114	·432	·1237
9	Ungsteiner	·442	·099	·566	·1575
10	Do.	·326	·096	·446	—
11	Hattenheimer	·397	·132	·562	—
12	Do.	·384	·099	·510	—
13	Do.	·502	·067	·586	·0545
14	Steinberger Cabinet	·431	·093	·537	·0675
15	Do. do.	·408	·124	·570	·0600
16	Forster Traminer Auslese	·255	·129	·416	—
17	Forster Traminer	·288	·120	·438	—
18	Bodenheimer	·348	·057	·420	--
19	Do.	·324	·085	·432	—
20	Marcobrunner Auslese	·435	·144	·615	·1050
21	Essenheimer	·330	·120	·480	·1575
22	Oestricher	·423	·123	·577	—
23	Niersteiner	·448	·183	·683	·0900
24	Stein Riessling	·401	·108	·536	·1125
25	Dromersheimer	·516	·138	·690	—
26	Erbacher	·420	·104	·552	—
27	Graefenberger	·390	·118	·540	—
28	Hardt Wine	·434	·114	·577	—
29	Jugenheimer	·375	·105	·506	—
30	Kiedricher	·414	·057	·486	—
31	Seltzener	·334	·086	·444	—
32	Grünhäuser	·487	·036	·053	·1575
33	Ingelheimer	·465	·135	·624	·1538
34	Zeltinger	·593	·087	·701	·2175
35	Dom Scharzhofberger	·386	·141	·563	·1575
	FRENCH WINES—				
36	Light Claret	·424	·147	·608	·0675
37	Do. do.	·435	·120	·580	—
38	Claret	·377	·215	·645	·1238
39	Do.	·338	·222	·617	—
40	Do.	·371	·198	·619	·1650
41	Do.	·323	·180	·548	·1838

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	18	19	20	21	22
Progressive Number.	NAME.	Dry residue (*minus* Ash). Found.	Dry residue (*minus* Ash). Calculated from Col. 7.	Difference between Cols. 18 and 19.	Percentage of Sugar.	Bitartrate of Potassium.
	GERMAN WINES—					
1	Leisten Riessling	1·137	2·097	+ ·960	1·328	—
2	Do. do.	1·080	2·029	+ ·949	·228	—
3	Do. do.	1·175	1·936	+ ·761	·182	—
4	Rauenthaler	1·015	1·701	+ ·686	·012	—
5	Do.	1·063	1·702	+ ·639	·062	·059
6	Do.	1·507	2·262	+ ·755	·067	·127
7	Do.	1·676	2·068	+ ·392	traces	·051
8	Do.	1·050	1·605	+ ·555	·119	·150
9	Ungsteiner	·992	1·656	+ ·664	·110	—
10	Do.	1·242	1·649	+ ·407	·020	—
11	Hattenheimer	1·215	2·105	+ ·890	none	—
12	Do.	1·208	1·779	+ ·571	traces	—
13	Do.	1·247	2·034	+ ·787	·017	·023
14	Steinberger Cabinet	1·200	1·753	+ ·553	·111	—
15	Do. do.	1·271	1·899	+ ·628	none	·0752
16	Forster Traminer Auslese . . .	1·155	1·999	+ ·844	·020	—
17	Forster Traminer	1·273	1·886	+ ·613	·279	—
18	Bodenheimer	·997	1·689	+ ·693	none	—
19	Do.	1·811	2·604	+ ·793	1·320	—
20	Macorbrunner Auslese	1·833	2·439	+ ·606	·499	—
21	Essenheimer	·700	1·446	+ ·746	·072	—
22	Oestricher	1·390	2·012	+ ·620	traces	—
23	Niersteiner	1·099	1·707	+ ·608	none	—
24	Stein Riessling	·960	1·835	+ ·875	·182	—
25	Dromersheimer	1·899	2·577	+ ·678	1·057	—
26	Erbacher	1·429	2·353	+ ·924	·282	—
27	Graefenberger	1·798	2·722	+ ·924	1·635	—
28	Hardt Wine	1·092	1·645	+ ·553	none	—
29	Jugenheimer	1·825	2·502	+ ·677	1·079	—
30	Kiedricher	1·316	2·305	+ ·989	·185	—
31	Seltzener	2·075	3·285	+ 1·210	·785	—
32	Grünhäuser	1·108	1·862	+ ·754	·132	—
33	Ingelheimer	1·815	2·332	+ ·517	·282	—
34	Zeltinger	2·530	3·220	+ ·690	·647	—
35	Dom Scharzhofberger	·980	1·784	+ ·804	·134	—
	FRENCH WINES—					
36	Light Claret	1·398	1·954	+ ·556	·431	·085
37	Do. do.	1·353	1·643	+ ·290	—	—
38	Claret	1·163	1·777	+ ·614	·113	—
39	Do.	1·682	2·011	+ ·329	—	—
40	Do.	1·165	1·791	+ ·626	·154	—
41	Do.	1·105	1·621	+ ·516	·095	—

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	23	24	25	26	27	28
Progressive Number.	NAME.	Total Ash.	Carbonate of Potassium in Ash.	Phosphate and Carbonate of Calcium in Ash.	Sulphates and Chlorides in Ash.	Phosphoric Acid in Ash.	Phosphoric Acid in insoluble part of Ash.
	GERMAN WINES—						
1	Leisten Riessling	·220	·007	·090	·123	·032	·025
2	Do. do.	·190	·007	·075	·108	·020	·015
3	Do. do.	·180	·007	·087	·085	·040	·020
4	Rauenthaler	·170	·007	·085	·078	·030	·017
5	Do.	·178	·009	·087	·082	·027	—
6	Do.	·175	·020	·110	·044	·047	·023
7	Do.	·171	·030	·091	·050	·034	—
8	Do.	·175	·043	·077	·054	·025	—
9	Ungsteiner	·155	·007	·090	·058	·030	·022
10	Do.	·172	·051	·050	·070	·037	·017
11	Hattenheimer	·205	·017	·100	·071	·042	·035
12	Do.	·136	·055	·058	·222	·017	—
13	Do.	·214	·003	·097	·114	·047	—
14	Steinberger Cabinet . . .	·145	·013	·085	·046	·035	·025
15	Do. do. . . .	·207	·016	·084	·107	·028	—
16	Forster Traminer Auslese .	·257	·031	·060	·165	·050	·020
17	Forster Traminer	·137	·044	·060	·032	·025	·020
18	Bodenheimer	·195	·058	·060	·076	·032	·017
19	Do.	·162	·038	·058	·065	·018	—
20	Marcobrunner Auslese . .	·192	·010	·115	·067	·035	·017
21	Essenheimer	·215	·037	·072	·104	·020	·020
22	Oestricher	·175	·006	·112	·045	·057	·037
23	Niersteiner	·181	·016	·071	·094	·025	—
24	Stein Riessling	·210	·007	·075	·128	·030	·030
25	Dromersheimer	·194	·056	·052	·087	·014	—
26	Erbacher	·188	·044	·071	·062	·029	—
27	Graefenberger	·181	·033	·069	·080	·024	—
28	Hardt Wine	·155	·033	·058	·064	·021	—
29	Jugenheimer	·175	·044	·049	·082	·024	—
30	Kiedricher	·184	·044	·065	·075	·021	—
31	Seltzener	·204	·044	·055	·105	·018	—
32	Grünhäuser	·153	·007	·090	·056	·035	·019
33	Ingelheimer	·220	·007	·075	·138	·043	·015
34	Zeltinger	·190	·007	·110	·073	·046	·013
35	Dom Scharzhofberger . . .	·153	·007	·083	·063	·035	·025
	FRENCH WINES—						
36	Light Claret	·208	·066	·048	·095	·033	·009
37	Do. do.	·202	·100	·058	·044	·030	—
38	Claret	·235	·045	·045	·145	·035	·010
39	Do.	·178	·055	·051	·072	—	—
40	Do.	·223	·041	·058	·124	·033	·018
41	Do.	·200	·038	·063	·099	·030	·005

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	3	4	29	30	31	32	33
Progressive Number.	NAME.	Colour.	Year.	Alcohol in Ethers.		Total Alcohol in Ethers.		Alcohol found in Ethers, expressed in per cents. of Alcohol, calculated in Ethers.
				Fixed.	Volatile.	Found.	Calcu-lated.	
	GERMAN WINES—							
1	Leisten Riessling . . .	White	1858	·0197	·0409	·0606	·0640	94·7
2	Do. do. . . .	,,	1859	·0205	·0331	·0536	·0539	99·8
3	Do. do. . . .	,,	1862	·0208	0254	·0462	·0507	91·0
4	Rauenthaler	,,	1859	·0199	·0239	·0438	·0458	95·7
5	Do.	,,	1862	—	—	—	—	—
6	Do.	,,	1862	—	—	—	—	—
7	Do.	,,	1864	·0175	·0256	·0431	·0581	74·1
8	Do.	,,	1865	—	—	—	—	—
9	Ungsteiner	,,	1862	·0180	·0184	·0364	·0470	77·5
10	Do	,,	1862	—	—	—	—	—
11	Hattenheimer	,,	1862	·0219	·0285	·0514	·0531	96·7
12	Do.	,,	1865	—	—	—	—	—
13	Do.	,,	1862	·0201	·0253	·0454	·0521	87·1
14	Steinberger Cabinet . .	,,	1857	·0225	·0239	·0464	·0495	93·7
15	Do. do. . . .	,,	1857	·0234	·0294	·0528	·0499	105·8
16	Forster Traminer Auslese	,,	1862	·0110	·0221	·0331	·0394	84·0
17	Forster Traminer . . .	,,	1862	—	—	—	—	—
18	Bodenheimer	,,	1862	·0132	·0230	·0362	·0359	100·8
19	Do.	,,	1865	—	—	—	—	—
20	Marcobrunner Auslese .	,,	1862	—	·0262	—	·0576	—
21	Essenheimer	,,	1862	·0118	·0156	·0274	·0370	74·0
22	Oestricher	,,	1862	·0209	·0354	·0563	·0556	101·2
23	Niersteiner	,,	—	—	—	—	—	—
24	Stein Riessling	,,	1858	·0203	·0311	·0514	·0496	103·7
25	Dromersheimer	,,	1865	—	—	—	—	—
26	Erbacher	,,	1865	—	—	—	—	—
27	Graefenberger	,,	1865	—	—	—	—	—
28	Hardt Wine	,,	1865	—	—	—	—	—
29	Jugenheimer	,,	1865	—	—	—	—	—
30	Kiedricher	,,	1865	—	—	—	—	—
31	Seltzener	,,	1865	—	—	—	—	—
32	Grünhäuser	—	1862	·0206	·0285	·0491	·0487	100·8
33	Ingelheimer	—	1862	·0164	·0213	·0377	·0520	72·5
34	Zeltinger	—	1862	·0193	·0212	·0405	·0533	76·5
35	Dom Scharzhofberger .	—	1862	·0206	·0144	·0350	·0489	71·0
	FRENCH WINES—							
36	Light Claret	Red	—	·0155	·0197	·0352	·0476	74·0
37	Do. do.	,,	—	·0144	·0170	·0314	·0506	62·1
38	Claret	,,	—	·0180	·0235	·0415	·0528	78·50
39	Do.	,,	—	—	—	—	—	—
40	Do.	,,	—	·0191	·0276	·0467	·0500	93·4
41	Do.	,,	—	·0166	·0216	·0382	·0429	88·8

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	3	4	5	6	7
Progressive Number.	NAME.	Colour.	Year.	Price.	Specific Gravity of Wine.	Specific Gravity of Wine, *minus* Alcohol.
	FRENCH WINES—*contd.*					
42	Claret	Red	1865	48*s.* per doz.	995·03	1010·63
43	Sauternes	White	—	24*s.* ,,	993·77	1011·95
44	Haut Barsac	,,	1854	50*s.* ,,	997·01	1012·17
45	Roussillon	Red	—	16*s.* ,,	1007·53	1032·48
46	Do.	,,	—	20*s.* ,,	1003·27	1027·52
47	Hermitage	,,	—	30*s.* ,,	995·38	1010·20
48	Do.	White	—	48*s.* ,,	989·53	1006·34
49	Burgundy	Red	—	18*s.* ,,	994·14	1009·50
50	Do.	,,	—	42*s.* ,,	992·84	1009·32
51	Do.	White	—	15*s.* ,,	991·36	1007·61
52	Do.	,,	—	34*s.* ,,	989·34	1007·22
53	Sparkling Burgundy .	,,	—	—	1027·00	1040·89
54	Beaujolais	Red	—	14*s.* ,,	994·73	1009·10
55	Bouzy Cabinet . . .	—	1857	62*s.* ,,	1020·31	1036·45
56	Do. do.	—	—	62*s.* ,,	1013·07	1030·50
57	Sillery	—	—	36*s.* ,,	1010·99	1026·67
	SPANISH WINES—					
58	Spanish Port	Red	—	18*s.* per doz.	1004·74	1029·97
59	Spanish Chablis . . .	—	—	—	991·60	1010·39
60	Manzanilla	—	—	—	985·98	1009·98
61	Montilla	—	—	—	986·55	1010·88
62	Sherry	—	1865	—	990·84	1017·56
63	Do. (7 years old) . .	—	—	—	997·93	1023·60
64	Do. (10 ,,) . .	—	—	—	998·30	1024·64
65	Do. (20 ,,) . .	—	—	—	996·24	1020·21
66	Do. (50 ,,) . .	—	—	—	997·25	1018·61
67	Do.	—	—	—	994·09	1019·01
68	Do.	—	—	—	995·80	1022·62
69	Do.	—	—	—	993·43	1018·80
70	Do.	—	—	—	—	—
71	Do.	—	—	—	987·47	1014·87
72	Do.	—	—	—	988·31	1014·54
73	Do. (from Peru) . .	—	—	—	996·82	1018·25
74	So-called Natural Sherry	—	—	58*s.* per doz.	986·01	1009·34
75	Do. do. . .	—	—	—	988·57	1010·62
76	Do. do. . .	—	—	48*s.* per doz.	992·34	1015·58
77	Do. do. . .	—	—	£55 per butt.	990·35	1010·95
78	Do. do. . .	—	—	70 ,,	990·82	1010·67
79	Do. do. . .	—	—	45 ,,	990·13	1010·53

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	8	9	10	11	12	13
Progressive Number.	NAME.	Specific Gravity of Distillate.		Percentage of Alcohol by weight in volume.		Difference between Cols. 10 and 11.	Strength of Wine in degrees of Proof Spirit.
		Found.	Calculated.	According to Col. 8.	According to Col. 9.		
	FRENCH WINES—*contd.*						
42	Claret	983·67	984·39	10·02	9·49	—·53	22·4
43	Sauternes	981·51	981·82	11·77	11·55	—·22	26·0
44	Haut Barsac	984·73	984·84	9·23	9·20	—·03	20·4
45	Roussillon	974·73	975·05	17·05	16·81	—·24	37·2
46	Do.	975·32	975·75	16·58	16·21	—·37	36·2
47	Hermitage	984·64	985·18	9·31	8·93	—·38	20·6
48	Do.	982·63	983·19	10·93	10·46	—·47	24·2
49	Burgundy	984·60	984·66	9·33	9·30	—·03	20·6
50	Do.	983·40	983·50	10·26	10·17	—·09	22·9
51	Do.	983·17	983·75	10·48	9·95	—·53	23·3
52	Do.	981·87	982·09	11·51	11·39	—·12	25·3
53	Sparkling Burgundy. . . .	985·59	986·11	8·65	8·29	—·36	19·1
54	Beaujolais	985·07	985·63	9·00	8·64	—·36	19·8
55	Bouzy Cabinet	983·66	983·85	10·04	9·87	—·17	22·3
56	Do. do.	982·19	982·57	11·25	11·01	—·24	24·9
57	Sillery	983·25	984·32	10·40	9·54	—·86	23·2
	SPANISH WINES—						
58	Spanish Port	974·63	974·77	17·13	16·98	—·15	38·1
59	Spanish Chablis	981·05	981·21	12·11	12·00	—·11	26·7
60	Manzanilla	976·03	976·00	16·00	16·02	+·02	35·6
61	Montilla	976·13	975·67	15·91	16·28	+·37	35·3
62	Sherry	—	973·40	—	18·04	—	39·8
63	Do. (7 years old) . .	—	974·33	—	17·35	—	38·7
64	Do. (10 ,,) . .	—	973·69	—	17·92	—	39·5
65	Do. (20 ,,) . .	—	976·03	—	16·00	—	35·6
66	Do. (50 ,,) . .	977·50	978·61	14·83	13·94	—·89	32·9
67	Do.	—	975·27	—	16·77	—	36·6
68	Do.	973·25	973·18	18·21	18·31	+·10	40·1
69	Do.	975·00	974·63	16·82	17·10	+·28	37·1
70	Do.	—	—	—	—	—	—
71	Do.	972·54	972·60	18·77	18·71	—·06	41·7
72	Do.	973·77	973·77	17·77	17·77	—·00	39·2
73	Do. (from Peru) . . .	—	978·57	—	13·96	—	30·8
74	So-called Natural Sherry .	977·07	976·67	15·16	15·48	+·32	33·5
75	Do. do. . .	978·14	977·95	14·30	14·46	+·16	31·8
76	Do. do. . .	977·17	976·76	15·08	15·42	+·34	33·4
77	Do. do. . .	—	979·40	—	13·34	—	29·4
78	Do. do. . .	—	979·15	—	13·51	—	29·9
79	Do. do. . .	—	979·60	—	13·20	—	29·2

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	14	15	16	17
Progressive Number.	NAME.	Free fixed Acid, calculated as Tartaric Acid.	Free volatile Acid, calculated as Acetic Acid.	Total free Acid, calculated as Tartaric Acid.	Real Tartaric Acid.
	FRENCH WINES—*contd.*				
42	Claret	·424	·174	·641	·1875
43	Sauternes	·447	·184	·649	·0195
44	Haut Barsac	·615	·183	·843	—
45	Roussillon	·311	·117	·460	·0525
46	Do.	·288	·171	·491	·0225
47	Hermitage	·383	·165	·626	·1050
48	Do.	·371	·180	·596	·1500
49	Burgundy	·386	·225	·668	·2025
50	Do.	·266	·186	·499	·1050
51	Do.	·405	·147	·589	·1785
52	Do.	·340	·149	·495	·0600
53	Sparkling Burgundy	·514	·114	·656	·2125
54	Beaujolais	·443	·189	·679	·1425
55	Bouzy Cabinet	·431	·090	·543	·1650
56	Do. do.	·441	·123	·592	·0860
57	Sillery	·360	·090	·472	·1690
	SPANISH WINES—				
58	Spanish Port	·285	·114	·427	·0600
59	Spanish Chablis	·213	·130	·356	none
60	Manzanilla	·255	·097	·362	—
61	Montilla	·277	·097	·383	—
62	Sherry	·263	·153	·454	·0225
63	Do. (7 years old)	·308	·168	·518	·0262
64	Do. (10 ,,)	·281	·162	·484	·0150
65	Do. (20 ,,)	·371	·141	·548	·0150
66	Do. (50 ,,)	·420	·165	·626	—
67	Do.	·270	·153	·461	·0187
68	Do.	·293	·132	·458	·0150
69	Do.	·255	·135	·424	—
70	Do.	—	—	—	—
71	Do.	·258	·138	·420	—
72	Do.	·192	·142	·372	—
73	Do. from Peru	·278	·216	·548	—
74	So-called Natural Sherry	·240	·116	·384	—
75	Do. do.	·289	·126	·446	—
76	Do. do.	·298	·064	·379	none
77	Do. do.	·308	·162	·510	—
78	Do. do.	·300	·162	·503	—
79	Do. do.	·308	·156	·503	—

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	18	19	20	21	22
Progressive Number.	NAME.	Dry residue (*minus* Ash). Found.	Dry residue (*minus* Ash). Calculated from Col. 7.	Difference between Cols. 18 and 19.	Percentage of Sugar.	Bitartrate of Potassium.
	FRENCH WINES—*contd.*					
42	Claret	1·613	2·235	+ ·622	·204	—
43	Sauternes	1·656	2·530	+ ·874	—	—
44	Haut Barsac	2·142	2·627	+ ·485	—	—
45	Roussillon	5·368	7·600	+2·232	5·100	—
46	Do.	4·473	7·247	+2·774	4·350	—
47	Hermitage	1·275	1·980	+ ·705	·060	—
48	Do.	·668	1·219	+ ·551	·077	—
49	Burgundy	1·160	1·957	+ ·797	·143	—
50	Do.	1·460	1·936	+ ·476	·110	—
51	Do.	·965	1·616	+ ·651	·069	—
52	Do.	·855	1·478	+ ·623	·119	—
53	Sparkling Burgundy	7·250	10·280	+3·030	8·600	—
54	Beaujolais	1·445	1·866	+ 421	·084	—
55	Bouzy Cabinet	5·366	9·070	+3·704	7·78	—
56	Do. do.	—	7·595	—	6·90	·052
57	Sillery	—	6·549	—	6·06	·105
	SPANISH WINES—					
58	Spanish Port	4·633	6·909	+2·276	5·260	—
59	Spanish Chablis	·940	1·523	+ ·940	·039	—
60	Manzanilla	1·101	1·556	+ ·455	none	—
61	Montilla	1·240	1·662	+ ·422	none	—
62	Sherry	2·260	3·437	+1·177	1·810	—
63	Do. (7 years old)	3·423	4·939	+1·516	2·970	—
64	Do. (10 ,,)	3·913	5·281	+1·368	3·510	—
65	Do. (20 ,,)	2·716	3·878	+1·162	1·960	—
66	Do. (50 ,,)	2·824	3·588	+ ·764	·560	—
67	Do.	3·058	3·864	+ ·806	2·565	—
68	Do.	3·575	4·663	+1·088	3·165	—
69	Do.	2·855	3·865	+1·010	—	—
70	Do.	—	—	—	·630	—
71	Do.	3·217*	3·772*	+ ·555	·420	—
72	Do.	3·135*	3·689*	+ ·554	·370	—
73	Do. (from Peru)	—	3·745	—	none	—
74	So-called Natural Sherry	·787	1·275	+ ·488	none	—
75	Do. do.	·872	1·569	+ ·697	·107	—
76	Do. do.	1·906	3·126	+1·220	·539	none
77	Do. do.	—	1·851	—	none	—
78	Do. do.	—	1·959	—	none	—
79	Do. do.	—	1·641	—	·068	—

* Including ash.

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	23	24	25	26	27	28
Progressive Number.	NAME.	Total Ash.	Carbonate of Potassium in Ash.	Phosphate and Carbonate of Calcium in Ash.	Sulphates and Chlorides in Ash.	Phosphoric Acid in Ash.	Phosphoric Acid in insoluble part of Ash.
	FRENCH WINES—*contd.*						
42	Claret	·225	·066	·055	·105	·030	·010
43	Sauternes	·246	·019	·084	·119	—	·030
44	Haut Barsac	·226	·011	·078	·137	·025	—
45	Roussillon	·365	·031	·095	·229	·030	·020
46	Do.	·400	·045	·100	·255	·025	·015
47	Hermitage	·298	·045	·093	·160	·050	·020
48	Do.	·193	·043	·060	·089	·025	·008
49	Burgundy	·220	·012	·108	·100	·028	·028
50	Do.	·208	·035	·075	·098	·033	·023
51	Do.	·150	·035	·070	·046	·023	·008
52	Do.	·170	·014	·095	·061	·050	·013
53	Sparkling Burgundy	·125	·024	·045	·056	·010	—
54	Beaujolais	·215	·048	·070	·025	—	·035
55	Bouzy Cabinet	·148	·014	·060	·074	·0225	·010
56	Do. do.	·110	·019	—	—	—	—
57	Sillery	·134	·043	—	—	—	—
	SPANISH WINES—						
58	Spanish Port	·385	·026	·100	·259	·038	·018
59	Spanish Chablis	·550	none	·071	·480	·018	—
60	Manzanilla	·482	,,	·064	·415	·025	—
61	Montilla	·544	·005	·078	·466	·035	—
62	Sherry	·515	·010	·080	·425	·020	·008
63	Do. (7 years old)	·550	·018	·095	·441	·025	·018
64	Do. (10 ,,)	·513	·007	·088	·418	·013	·013
65	Do. (20 ,,)	·638	·007	·095	·536	·045	·045
66	Do. (50 ,,)	·575	·011	·096	·474	·014	—
67	Do.	·450	·007	·080	·363	·018	·008
68	Do.	·560	·024	·075	·461	·020	·008
69	Do.	·434	·011	·100	·323	—	—
70	Do.	—	—	—	—	—	—
71	Do.	—	—	—	—	—	—
72	Do.	—	—	—	—	—	—
73	Do. from Peru	·450	·021	·090	·234	—	·020
74	So-called Natural Sherry	·541	·002	·087	·452	·046	—
75	Do. do	·557	·007	·094	·456	·023	—
76	Do. do.	·453	·027	·061	·365	·020	—
77	Do. do.	·458	·010	—	—	—	—
78	Do. do.	·368	·007	—	—	—	—
79	Do. do.	·512	·003	—	—	—	—

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	3	4	29	30	31	32	33
Progressive Number.	NAME.	Colour.	Year.	Alcohol in Ethers.		Total Alcohol in Ethers.		Alcohol found in Ethers, expressed in per cents. of Alcohol, calculated in Ethers.
				Fixed.	Volatile.	Found.	Calculated.	
	FRENCH WINES—*contd.*							
42	Claret	Red	1865	·0186	·0248	·0434	·0581	74·6
43	Sauternes	White	—	—	—	—	—	—
44	Haut Barsac	,,	1854	—	—	—	—	—
45	Roussillon	Red	—	—	—	—	—	—
46	Do.	,,	—	·0223	·0297	·0520	·0684	75·9
47	Hermitage	,,	—	·0175	·0216	·0391	·0533	73·4
48	Do.	White	—	·0159	·0281	·0440	·0571	76·9
49	Burgundy	Red	—	·0186	·0244	·0430	·0570	75·5
50	Do.	,,	—	·0190	·0184	·0374	·0460	81·3
51	Do.	White	—	·0144	·0189	·0333	·0551	60·2
52	Do.	,,	—	·0138	·0225	·0363	·0605	60·0
53	Sparkling Burgundy . .	,,	—	—	—	—	—	—
54	Beaujolais	Red	—	·0144	·0170	·0314	·0551	56·9
55	Bouzy Cabinet	—	1857	·0278	·0313	0591	·0498	116·5
	SPANISH WINES—							
58	Spanish Port	Red	—	·0231	·0267	·0498	·0613	81·3
59	Spanish Chablis . . .	—	—	—	—	—	—	—
60	Manzanilla	—	—	—	—	—	—	—
61	Montilla	—	—	—	—	—	—	—
62	Sherry	—	1865	·0173	·0285	·0458	·0681	67·2
63	Do. (7 years old) . . .	—	1860	·0290	·0391	·0681	·0749	90·8
64	Do. (10 ,,) . . .	—	1857	·0262	·0469	·0731	·0722	101·2
65	Do. (20 ,,) . . .	—	1847	·0350	·0442	·0792	·0738	107·2
66	Do. (50 ,,) . . .	—	—	·0377	·0385	·0762	·0799	95·3
67	Do.	—	—	·0206	·0216	·0422	·0639	66·1
68	Do.	—	—	·0294	·0354	·0648	·0695	93·2
69	Do.	—	—	—	—	—	—	—
70	Do.	—	—	—	—	—	—	—
71	Do.	—	—	—	—	—	—	—
72	Do.	—	—	—	—	—	—	—
73	Do. from Peru	—	—	—	—	—	—	—
74	So-called Natural Sherry	—	—	—	—	—	—	—
75	Do. do. . .	—	—	—	—	—	—	—
76	Do. do. . .	—	—	—	—	—	—	—
77	Do. do. . .	—	—	—	—	—	—	—
78	Do. do. . .	—	—	—	—	—	—	—
79	Do. do. . .	—	—	—	—	—	—	—

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	3	4	5	6	7
Progressive Number.	NAME.	Colour.	Year.	Price.	Specific Gravity of Wine.	Specific Gravity of Wine, *minus* Alcohol.
	SICILIAN WINES—					
80	Marsala	Pale	—	18*s.* per doz.	995·98	1020·46
81	Do.	Brown	—	20*s.* ,,	1001·34	1025·36
82	Do.	Pale	—	20*s.* ,,	994·11	1018·56
83	Do.	Gold	—	20*s.* ,,	999·65	1024·25
84	Do.	,,	—	16*s.* ,,	996·65	1020·83
85	Bronte	Gold	—	—	997·91	1021·21
	PORTUGUESE WINES—					
86	Port	—	—	—	1007·45	1032·13
87	Do.	—	—	—	998·73	1025·86
88	Do.	—	—	—	997·11	1023·34
89	Do.	—	1851	—	1002·49	1027·14
90	Do.	—	1853	—	1008·43	1033·19
91	Do.	—	1851	—	999·24	1025·01
92	Do.	—	1864	—	1004·76	1031·40
93	Do.	—	1861	—	987·18	1015·28
94	Do.	—	1854	—	997·42	1022·59
95	Do.	—	1851	—	994·98	1017·42
96	Do.	—	1842	—	986·95	1013·25
97	So-called Natural Port	—	—	—	997·16	1018·46
98	Do. do.	—	—	—	995·19	1010·24
99	Cheap Port	—	—	—	1003·92	1027·53
	HUNGARIAN WINES—					
100	Carlowitz	Red	—	16*s.* per doz.	991·83	1008·62
101	Do.	,,	—	21*s.* ,,	992·07	1009·07
102	Erlau	,,	—	28*s.* ,,	991·99	1008·81
103	Menés	,,	—	34*s.* ,,	994·27	1010·88
104	Kobányai	White	—	16*s.* ,,	991·67	1006·80
105	Rust	,,	—	21*s.* ,,	990·57	1007·59
106	Badacsonyi	,,	—	24*s.* ,,	992·05	1008·32
107	Villanyie Muscat	,,	—	28*s.* ,,	989·42	1008·07
108	Do. do.	,,	—	34*s.* ,,	992·88	1007·98
109	Tokay	,,	—	42*s.* ,,	993·09	1008·00

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	8	9	10	11	12	13
Progressive Number.	NAME.	Specific Gravity of Distillate.		Percentage of Alcohol by weight in volume.		Difference between Cols. 10 and 11.	Strength of Wine in degrees of Proof Spirit.
		Found.	Calculated.	According to Col. 8.	According to Col. 9.		
	SICILIAN WINES—						
80	Marsala	975·53	975·52	16·39	16·41	+ ·02	36·3
81	Do.	975·68	975·98	16·27	16·03	—·24	35·9
82	Do.	975·41	975·45	16·50	16·55	+ ·05	36·2
83	Do.	975·43	975·40	16·46	16·48	+ ·02	36·2
84	Do.	975·64	975·82	16·30	16·16	—·14	35·9
85	Bronte	—	976·70	—	15·46	—	33·5
	PORTUGUESE WINES—						
86	Port	975·02	975·32	16·82	16·58	—·24	36·1
87	Do.	972·51	972·87	18·81	18·50	—·31	41·4
88	Do.	973·73	973·78	17·84	17·80	—·04	38·0
89	Do.	—	975·35	—	16·54	—	36·6
90	Do.	—	975·24	—	16·63	—	36·4
91	Do.	974·04	974·23	17·58	17·47	—·11	38·2
92	Do.	973·25	973·36	18·06	18·00	—·06	40·1
93	Do.	971·86	971·90	19·24	19·20	—·04	42·5
94	Do.	974·66	974·82	17·08	16·96	—·12	37·7
95	Do.	977·27	977·56	15·01	14·78	—·23	33·2
96	Do.	—	973·71	—	17·76	—	39·4
97	So-called Natural Port	—	978·70	—	13·87	—	30·7
98	Do. do.	983·98	984·95	9·78	9·09	—·69	21·9
99	Cheap Port	—	975·39	—	16·48	—	36·4
	HUNGARIAN WINES—						
100	Carlowitz	983·20	983·21	10·45	10·44	—·01	23·2
101	Do.	982·33	982·99	11·16	9·63	—·53	24·7
102	Erlau	982·48	983·18	11·05	10·46	—·59	24·3
103	Menés	983·03	983·39	10·60	10·26	—·34	23·5
104	Kobányai	984·54	984·87	9·38	9·15	—·23	20·7
105	Rust	985·52	982·98	11·05	10·68	—·37	19·2
106	Badacsonyi	983·24	983·73	10·30	9·85	—·45	23·2
107	Villanyie Muscat	981·27	981·35	11·96	11·89	—·07	26·4
108	Do. do.	984·53	984·90	9·39	9·14	—·25	20·8
109	Tokay	984·61	985·09	9·34	9·00	—·34	20·6

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	14	15	16	17
Progressive Number.	NAME.	Free fixed Acid, calculated as Tartaric Acid.	Free volatile Acid, calculated as Acetic Acid.	Total free Acid, calculated as Tartaric Acid.	Real Tartaric Acid.
	SICILIAN WINES—				
80	Marsala	·246	·107	·379	—
81	Do.	·293	·093	·409	—
82	Do.	·254	·136	·436	—
83	Do.	·225	·138	·398	·0150
84	Do.	·188	·111	·326	none
85	Bronte	·390	·126	·548	·0997
	PORTUGUESE WINES—				
86	Port	·289	·087	·398	·0075
87	Do.	·263	·108	·398	·0075
88	Do.	·274	·114	·416	·0150
89	Do.	·188	·174	·405	—
90	Do.	·248	·120	·398	—
91	Do.	·259	·123	·413	—
92	Do.	·308	·084	·413	·0225
93	Do.	·259	·129	·420	·0150
94	Do.	·354	·107	·488	·0225
95	Do.	·278	·186	·510	·0150
96	Do.	·266	·108	·401	·0150
97	So-called Natural Port	·238	·210	·484	—
98	Do. do.	·465	·162	·668	·240
99	Cheap Port	·268	·119	·414	—
	HUNGARIAN WINES—				
100	Carlowitz	·395	·183	·630	·0480
101	Do.	·356	·249	·668	·0600
102	Erlau	·439	·165	·645	·3000
103	Menés	·355	·169	·570	·0810
104	Kobányai	·448	·116	·594	·0930
105	Rust	·315	·281	·665	·0300
106	Badacsonyi	·399	·159	·599	—
107	Villanyie Muscat	·349	·192	·589	—
108	Do. do.	·533	·147	·716	·0675
109	Tokay	·474	·180	·699	·0375

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	18	19	20	21	22
Progressive Number.	NAME.	Dry residue (*minus* Ash). Found.	Calculated from Col. 7.	Difference between Cols. 18 and 19.	Percentage of Sugar.	Bitartrate of Potassium.
	SICILIAN WINES—					
80	Marsala	3·354	4·572	+1·218	1·093	—
81	Do.	4·132	5·780	+1·648	4·700	—
82	Do.	2·822	4·050	+1·228	1·050	—
83	Do.	3·918	5·581	+1·663	3·760	—
84	Do.	3·633	4·865	+1·232	3·240	—
85	Bronte	3·995	4·504	+ ·509	3·160	—
	PORTUGUESE WINES—					
86	Port	5·528	7·625	+2·097	6·346	—
87	Do	4·393	6·151	+1·758	4·662	—
88	Do.	3·988	5·731	+1·743	4·039	—
89	Do.	4·880	6·129	+1·249	4·170	—
90	Do.	6·385	8·016	+1·631	—	—
91	Do.	4·598	5·982	+1·382	3·840	—
92	Do.	5·688	7·553	+1·865	4·331	—
93	Do.	2·458	3·398	+ ·940	1·050	—
94	Do.	3·710	5·260	+1·550	2·284	—
95	Do.	2·855	3·992	+1·137	1·591	—
96	Do.	2·090	2·936	+ ·846	1·010	—
97	So-called Natural Port	—	3·630	—	2·640	—
98	Do. do.	1·648	2·096	+ ·448	·178	—
99	Cheap Port	4·780	6·406	+1·626	4·220	—
	HUNGARIAN WINES—					
100	Carlowitz	1·909	1·812	− ·097	none	—
101	Do.	1·373	1·918	+ ·545	·147	·075
102	Erlau	1·238	1·793	+ ·555	none	·169
103	Menés	2·190	2·393	+ ·203	·228	—
104	Kobányai	1·202	1·355	+ ·153	·066	—
105	Rust	1·089	1·548	+ ·459	·089	—
106	Badacsonyi	1·008	1·683	+ ·675	—	—
107	Villanyie Muscat	·946	1·635	+ ·689	·185	—
108	Do. do.	·970	1·661	+ ·691	·062	·047
109	Tokay	·943	1·640	+ ·697	·025	·047

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1 Progressive Number.	2 NAME.	23 Total Ash.	24 Carbonate of Potassium in Ash.	25 Phosphate and Carbonate of Calcium in Ash.	26 Sulphates and Chlorides in Ash.	27 Phosphoric Acid in Ash.	28 Phosphoric Acid in insoluble part of Ash.
	SICILIAN WINES—						
80	Marsala	·324	·007	·091	·226	·023	—
81	Do.	·356	·014	·116	·226	·023	—
82	Do.	·338	·006	·107	·221	·035	—
83	Do.	·313	·055	·065	·192	·023	·010
84	Do.	·225	·021	·050	·154	·018	·010
85	Bronte	·455	·000	·095	·360	·020	·017
	PORTUGUESE WINES—						
86	Port	·213	·045	·072	·096	·035	·010
87	Do.	·235	·062	·080	·093	·025	·018
88	Do.	·120	·038	·068	·015	·033	·010
89	Do.	·410	·117	·135	·158	·033	·015
90	Do.	·250	·097	·060	·093	·250	·150
91	Do.	·210	·062	·048	·100	·030	·005
92	Do.	·248	·048	·065	·134	·035	·018
93	Do.	·240	·062	·048	·134	·029	·008
94	Do.	·258	·066	·055	·137	·033	·013
95	Do.	·220	·069	·050	·101	·029	·008
96	Do.	·210	·069	·045	·086	·033	·010
97	So-called Natural Port	·535	·124	·050	·361	traces	traces
98	Do. do.	·245	·008	·095	·143	·025	·013
99	Cheap Port	·321	·062	·120	·138	·030	·023
	HUNGARIAN WINES—						
100	Carlowitz	·181	·047	·077	·057	·035	—
101	Do.	·185	·041	·053	·091	·035	·015
102	Erlau	·214	·052	·078	·084	·030	—
103	Menés	·188	·075	·051	·062	·040	—
104	Kobányai	·178	·033	·062	·083	·025	—
105	Rust	·195	·033	·078	·083	·038	—
106	Badacsonyi	·207	·055	·090	·062	·032	—
107	Villanyie Muscat	·194	·005	·110	·079	·040	—
108	Do. do.	·175	·014	·080	·081	·025	·020
109	Tokay	·188	·012	·085	·090	·025	·015

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	3	4	29	30	31	32	33
Progressive Number.	NAME.	Colour.	Year.	Alcohol in Ethers.		Total Alcohol in Ethers.		Alcohol found in Ethers, expressed in per cents. of Alcohol, calculated in Ethers.
				Fixed.	Volatile.	Found.	Calculated.	
	SICILIAN WINES—							
80	Marsala	Pale	—	—	—	—	—	—
81	Do.	Brown	—	—	—	—	—	—
82	Do.	Pale	—	—	—	—	—	—
83	Do.	Gold	—	·0333	·0216	·0549	·0550	99·8
84	Do.	,,	—	·0256	·0189	·0445	·0447	99·3
85	Bronte	—	—	—	—	—	—	—
	PORTUGUESE WINES—							
86	Port	—	—	·0289	·0202	·0491	·0560	87·6
87	Do.	—	—	·0335	·0202	·0537	·0619	86·6
88	Do.	—	—	·0336	·0235	·0571	·0619	92·3
89	Do.	—	1851	—	—	—	—	—
90	Do.	—	1853	—	—	—	—	—
91	Do.	—	1851	·0318	·0294	·0612	·0605	101·1
92	Do.	—	1864	·0302	·0128	·0430	·0620	69·4
93	Do.	—	1861	·0261	·0216	·0477	·0669	71·4
94	Do.	—	1854	·0351	·0220	·0572	·0697	84·9
95	Do.	—	1851	·0250	·0304	·0554	·0650	85·2
96	Do.	—	1842	·0283	·0331	·0614	·0595	103·2
97	So-called Natural Port .	—	—	—	—	—	—	—
98	Do. do. .	—	—	·0199	·0152	·0351	·0598	58·6
99	Cheap Port	—	—	—	—	—	—	—
	HUNGARIAN WINES—							
100	Carlowitz	Red	—	—	—	—	—	—
101	Do.	,,	—	·0151	·0358	·0509	·0656	77·6
102	Erlau	,,	—	—	—	—	—	—
103	Menés	,,	—	—	—	—	—	—
104	Kobányai	White	—	—	—	—	—	—
105	Rust	,,	—	—	—	—	—	—
106	Badacsonyi	,,	—	—	—	—	—	—
107	Villanyie Muscat . . .	,,	—	—	—	—	—	—
108	Do. do. . . .	,,	—	·0186	·0271	·0457	·0613	74·5
109	Tokay	,,	—	·0162	·0273	·0435	·0596	73·0

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	3	4	5	6	7
Progressive Number.	NAME.	Colour.	Year.	Price.	Specific Gravity of Wine.	Specific Gravity of Wine, *minus* Alcohol.
	GREEK WINES—					
110	Keffesia	Red	—	24s. per doz.	996·06	1011·82
111	Keffesia	White	—	20s. ,,	992·74	1009·62
112	Patras	,,	—	20s. ,,	994·56	1011·02
113	Thiera	Gold	—	36s. ,,	993·17	1013·86
114	St. Elie	White	—	28s. ,,	992·25	1010·99
115	Lachrymæ Christi	Dark	—	42s. ,,	1113·53	1126·84
116	Santorin	White	—	24s. ,,	994·74	1013·48
117	Patras	,,	—	—	1052·33	1069·27
	CAPE WINES—					
118	Imitation Sherry	—	—	18s. per doz.	996·11	1024·49
119	Do. do.	—	—	22s. ,,	995·23	1018·87
120	Do. do.	—	—	—	995·84	1020·18
121	Do. do.	—	—	22s. ,,	999·85	1024·29
122	Imitation Port	—	—	22s. ,,	1011·95	1036·83
123	Do. do.	—	—	18s. ,,	1013·52	1038·09
124	Imitation Madeira	—	-	18s. ,,	991·03	1024·74
	ATLANTIC ISLANDS—					
125	Madeira	—	—	36s. per doz.	997·10	1022·90
126	Do.	—	—	60s. ,,	993·94	1018·95
127	Do.	-	1812	—	994·15	1019·59
	ELBE WINES—					
128	Imitation Sherry	—	-	15s. per doz.	993·02	1016·72
	AUSTRALIAN WINES—					
129	Adelaide	White	—	—	985·05	1006·95
130	Adelaide	,,	-	—	994·01	1012·12
131	Adelaide	Red	—	—	994·33	1010·43
132	Adelaide	,,	—	—	993·40	1009·96
133	Adelaide	,,	—	—	1018·86	1045·00

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	8	9	10	11	12	13
Progressive Number.	NAME.	Specific Gravity of Distillate.		Percentage of Alcohol by weight in volume.		Difference between Cols. 10 and 11.	Strength of Wine in degrees of Proof Spirit.
		Found.	Calculated.	According to Col. 8.	According to Col. 9.		
	GREEK WINES—						
110	Keffesia	983·60	984·24	10·09	9·59	—·50	22·5
111	Keffesia	982·95	983·12	10·67	10·52	—·15	23·6
112	Patras	983·10	983·54	10·54	10·15	—·39	23·4
113	Thiera	979·04	979·30	13·60	13·41	—·19	30·0
114	St. Elie	980·91	981·25	12·20	11·95	—·25	27·1
115	Lachrymæ Christi	986·45	986·69	8·06	7·91	—·15	17·8
116	Santorin	981·01	981·26	12·16	11·97	—·19	27·0
117	Patras	982·04	983·06	11·39	10·61	—·78	32·1
	CAPE WINES—						
118	Imitation Sherry	975·39	975·62	16·51	16·32	—·19	36·6
119	Do. do.	975·57	976·36	16·36	15·72	—·64	36·1
120	Do. do.	975·39	975·66	16·50	16·28	—·22	36·6
121	Do. do.	975·35	975·56	16·54	16·38	—·16	36·6
122	Imitation Port	974·76	975·12	17·10	16·75	—·35	37·7
123	Do. do.	975·31	975·43	16·57	16·47	—·10	36·7
124	Imitation Madeira	966·22	966·29	22·36	22·31	—·05	51·7
	ATLANTIC ISLANDS—						
125	Madeira	973·94	974·20	17·66	17·44	—·22	39·1
126	Do.	974·44	974·99	17·30	16·81	—·49	38·2
127	Do.	974·11	974·56	17·53	17·16	—·37	38·7
	ELBE WINES—						
128	Imitation Sherry	976·40	976·30	15·70	15·80	+ ·10	34·9
	AUSTRALIAN WINES—						
129		977·87	970·10	14·52	14·34	—·18	32·2
130		980·90	981·89	12·22	11·48	—·74	26·8
131	Adelaide	983·09	983·90	10·62	10·03	—·59	23·5
132		982·58	983·44	10·97	10·22	—·75	24·2
133		973·53	973·86	17·99	17·73	—·26	40·1

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	14	15	16	17
Progressive Number.	NAME.	Free fixed Acid, calculated as Tartaric Acid.	Free volatile Acid, calculated as Acetic Acid.	Total free Acid, calculated as Tartaric Acid.	Real Tartaric Acid.
	GREEK WINES—				
110	Keffesia	·225	·363	·679	·0075
111	Keffesia	·431	·153	·623	·0150
112	Patras	·341	·300	·716	·0675
113	Thiera	·233	·177	·454	·0300
114	St. Elie	·454	·168	·664	—
115	Lachrymæ Christi	·386	·204	·642	—
116	Santorin	·263	·159	·461	—
117	Patras	·542	·136	·712	·1274
	CAPE WINES—				
118	Imitation Sherry	·210	·126	·368	·0150
119	Do. do.	·263	·099	·386	none
120	Do. do.	·227	·101	·353	—
121	Do. do.	·330	·120	·480	·0150
122	Imitation Port	·304	·129	·465	·0318
123	Do. do.	·278	·108	·403	none
124	Imitation Madeira	·224	·147	·366	·0040
	ATLANTIC ISLANDS—				
125	Madeira	·281	·183	·510	—
126	Do.	·326	·168	·536	·0300
127	Do.	·420	·327	·825	none.
	ELBE WINES—				
128	Imitation Sherry	·229	·095	·347	none
	AUSTRALIAN WINES—				
129	Adelaide	·274	·153	·465	·0750
130	Adelaide	·399	·270	·739	·0300
131	Adelaide	·394	·285	·751	·0300
132	Adelaide	·370	·323	·774	·1200
133	Adelaide	·340	·388	·825	·0600

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	18	19	20	21	22
Progressive Number.	NAME.	Dry residue (*minus* Ash). Found.	Dry residue (*minus* Ash). Calculated from Col. 7.	Difference between Cols. 18 and 19.	Percentage of Sugar.	Bitartrate of Potassium.
	GREEK WINES—					
110	Keffesia	1·700	2·387	+ ·687	·104	—
111	Keffesia	1·158	1·885	+ ·727	·133	—
112	Patras	1·818	2·332	+ ·514	·200	—
113	Thiera	1·855	2·763	+ ·908	·364	—
114	St. Elie	1·516	2·168	+ ·652	·112	—
115	Lachrymæ Christi	24·262	32·022	+5·238	26·784	—
116	Santorin	2·230	2·645	+ ·415	·386	—
117	Patras	13·129	17·220	+4·091	15·150	—
	CAPE WINES—					
118	Imitation Sherry	3·377	5·700	+2·323	3·120	—
119	Do. do.	3·146	4·132	+ ·986	2·080	—
120	Do. do.	3·718	4·483	+ ·765	1·241	—
121	Do. do.	4·167	5·513	+1·346	2·479	·028
122	Imitation Port	8·028	8·735	+ ·707	5·196	—
123	Do. do.	6·860	9·070	+2·210	6·760	none
124	Imitation Madeira	4·909	5·783	+ ·874	1·400	—
	ATLANTIC ISLANDS—					
125	Madeira	3·678	5·106	+1·428	2·850	—
126	Do.	2·645	4·046	+1·401	2·080	—
127	Do.	2·294	4·276	+1·982	1·629	—
	ELBE WINES—					
128	Imitation Sherry	2·818	3·924	+1·106	2·700	none
	AUSTRALIAN WINES—					
129		1·005	1·356	+ ·351	·116	—
130		2·273	2·521	+ ·248	·250	—
131	Adelaide	1·238	2·084	+ ·846	·094	—
132		1·568	2·085	+ ·517	·131	—
133		9·413	10·974	+1·561	7·700	—

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	23	24	25	26	27	28
Progressive Number.	NAME.	Total Ash.	Carbonate of Potassium in Ash.	Phosphate and Carbonate of Calcium in Ash.	Sulphates and Chlorides in Ash.	Phosphoric Acid in Ash.	Phosphoric Acid in insoluble part of Ash.
	GREEK WINES—						
110	Keffesia	·300	·117	·075	·108	·021	·021
111	Keffesia	·270	·083	·060	·127	·013	·010
112	Patras	·225	·007	·100	·118	·025	·025
113	Thiera	·375	·021	·105	·249	·045	·013
114	St. Elie	·305	·041	·063	·201	·025	·015
115	Lachrymæ Christi	·568	·135	·130	·303	·055	·018
116	Santorin	·385	·021	·095	·269	·034	·023
117	Patras	·306	·022	·120	·165	·028	·028
	CAPE WINES—						
118	Imitation Sherry	·285	·052	·068	·166	·018	·015
119	Do. do.	·337	·026	·084	·227	·028	·018
120	Do. do.	·332	·007	·123	·202	·040	—
121	Do. do.	·353	·028	·091	·235	·023	·013
122	Imitation Port	·365	·035	·110	·220	·030	·020
123	Do. do.	·363	·059	·080	·224	·043	·018
124	Imitation Madeira	·275	·024	·068	·183	·015	·015
	ATLANTIC ISLANDS—						
125	Madeira	·375	·052	·105	·218	·035	—
126	Do.	·390	·028	·110	·252	·043	·015
127	Do.	·359	·017	·149	·193	·050	—
	ELBE WINES—						
128	Imitation Sherry	·163	·017	·053	·093	·015	·015
	AUSTRALIAN WINES—						
129		·195	·031	·045	·119	·015	·015
130		·273	·031	·075	·167	·010	·010
131	Adelaide	·275	·028	·075	·173	·011	·005
132		·215	·041	·100	·074	·039	·030
133		·310	·045	·075	·190	·023	·010

TABLES EXHIBITING THE RESULTS OF THE ANALYSES OF VARIOUS WINES FROM THE PRINCIPAL WINE-PRODUCING COUNTRIES—*continued.*

1	2	3	4	29	30	31	32	33
Progressive Number.	NAME.	Colour.	Year.	Alcohol in Ethers.		Total Alcohol in Ethers.		Alcohol found in Ethers, expressed in per cents. of Alcohol, calculated in Ethers.
				Fixed.	Volatile.	Found.	Calculated.	
	GREEK WINES—							
110	Keffesia	Red	—	·0173	·0350	·0523	·0616	86·4
111	Keffesia	White	—	·0145	·0304	·0449	·0592	75·8
112	Patras	—	—	·0224	·0214	·0438	·0690	63·6
113	Thiera	—	—	·0245	·0207	·0452	·0530	85·1
114	St. Elie	—	—	·0385	·0179	·0564	·0707	79·7
115	Lachrymæ Christi	—	—	·0460	·0175	·0635	·0486	—
116	Santorin	—	—	·0254	·0147	·0402	·0488	82·1
117	Patras	—	—	·0414	·0275	·0689	·0714	96·5
	CAPE WINES—							
118	Imitation Sherry	—	—	·0224	·0175	·0399	·0502	79·5
119	Do. do.	—	—	—	—	—	—	—
120	Do. do.	—	—	—	—	—	—	—
121	Do. do.	—	—	—	—	—	—	—
122	Imitation Port	—	—	—	—	—	—	—
123	Do. do.	—	—	·0287	·0207	·0494	·0573	86·1
124	Imitation Madeira	—	—	·0292	·0335	·0627	·0828	75·7
	ATLANTIC ISLANDS—							
125	Madeira	—	—	·0202	·0378	·0580	·0745	77·8
126	Do.	—	—	·0305	·0382	·0687	·0774	88·7
127	Do.	—	1812	·0460	·0772	·1232	·1207	102·1
	ELBE WINES—							
128	Imitation Sherry	—	—	·0177	·0129	·0306	·0460	66·4
	AUSTRALIAN WINES—							
129	Adelaide	White	—	·0127	·0409	·0536	·0575	93·1
130		,,	—	·0212	·0370	·0582	·0787	73·9
131		Red.	—	·0151	·0336	·0487	·0711	68·5
132		,,	—	·0157	·0423	·0580	·0754	76·6
133		,,	—	—	—	—	—	—

VITICULTURAL MAP
OF THE
DEPARTMENT
OF THE
GIRONDE.
GULF OF GASCOGNE
ROYAN
GIRONDE
MEDOC
ST VIVIEN
ST SURIN DE CADOURNE
LESPARRE
ST ESTEPHE
PAUILLAC
CHAT. LAFITE
CHAT. LATOUR
ST JULIEN
ST LAURENT
CHAT. MARGAUX
MARGAUX
CASTELNAU
LABARDE
LUDON
BLANQUEFORT
BORDEAUX
CHAT. HAUT BRION
PESSAC
GRAVES
DUNES DE LA GIRONDE
BASSIN D'ARCACHON
AUDENCE
LA TESTE
BAYONNE A BORDEAUX
BEHU
MIRAMBEAU
MONTENDRE
MOULIEU
BLAYAIS
ST SAVIN
BLAYE
BOURG
ST ANDRE DE CUBZAC
FRONSADAIS
FRONSAC
EUITRES
LIBOURNAIS
LIBOURNE
CASTILLON
CARBON BLANC
CHARENTE INFRE.
DORDOGNE
VELINES
ENTRE DEUX MERS
CÔTES
BRU
PUJOLS
PELLEGRUE
CREON
TARGON
SAUVETERRE
MONSEGUR
DURAS
PODENSAC
CADILLAC
BARSAC
ST MACAIRE
PREIGNAC
CHAT. YQUEM
BOMMES
SAUTERNES
LANGON
LAREOLE
MARMANDT
NEILHAN
CETTE
AUROS
VINS BLANCS
VILLANDRAUT
BAZAS
ST SYMPHORIEN
CRIGNOLS
CAPTIEUX
LANDES
LOT ET GARONNE

CHAPTER X.

WINES OF THE GIRONDE.

The Gironde.—The Médoc.—Vines cultivated in the Médoc.—Modes of cultivating the soil and vine in the Médoc.—The vintage and vinification in the Médoc.—Qualification of the wines of the Médoc.—Classified growths —First class.—Second class.—Third, fourth, and fifth class.—Bourgeois ; paysans.—Prices of the Médoc wines.—Mode of effecting sales in the Médoc.—The consumption of Médoc wines.—Statistics of viticultural property and production of the Médoc.—The Graves.—Red wines of the Graves.—White wines of the Graves or Sauternes district.—Vintage.—Classification of the wines.—Description of the wines.—Viticultural statistics of the Sauternes district producing white wines.—Viticultural statistics of the part of the Graves or Sauternes district producing red wines.—Wines of the hill-sides or côtes of the Gironde.—Vineyard of St. Emilion.—Classification of the wines of St. Emilion, and enumeration of the communes of the Libourne district.—Viticultural statistics of the district of Blaye.—Viticultural statistics of the district on the right bank of the Garonne producing white wines.—Viticultural statistics of the district o the Marshes, Palus, and Entre deux Mers.

THE GIRONDE.

THE Department of the Gironde possesses about 140,000 hectares of vineyards, producing annually on an average 250,000 tonneaux, or 2,280,000 hectolitres of wine. These wines are celebrated for their variety, their remarkable perfection, the low prices of their common qualities, the enormous prices of their first qualities, and by the remarkable trade to all parts of the world to which they give rise. The estimated average value of two-sixths of the annual produce is 50 francs the barrique; two-sixths, 125 francs; one-sixth is 250 francs; and the last sixth, 500 francs the barrique, immediately after the spring racking. This gives a gross production of 280 millions of francs, and, if we deduct from that an average annual expenditure of 500 francs per hectare, we find that the Gironde raises an annual clear value of 180,000,000 francs in the shape of wine alone.

The Gironde is practically divisible into five wine-producing districts—namely, the Médoc, a district on the left bank of the Garonne, extending from Blanquefort to the sea; the Graves, or high plains about the confluence of the Garonne and Dordogne; the Côtes, or inclined banks of the right side of the Garonne; the Palus, or low marshy territory on both banks of the Garonne in the more immediate neighbourhood of Bordeaux; and the district of Entre deux mers, or low land between the Dordogne and Garonne.

THE MÉDOC.

The Médoc, geographically so called, is the tongue of land which forms the left border of the Garonne after its union with the Dordogne, called the Gironde; and it extends from Blanquefort, a little town about fifteen kilometres west of Bordeaux, to the sea. But the Médoc of the oinophilist begins only west of Ludon, in the Commune of Macau. It produces the wines of Labarde and Cantenac; in its very heart those of Margaux. Further on are the great growths of Saint Julien and Pauillac. Still farther west it produces the St. Estèphe, and at its western limits the wines of Saint Seurin-de-Cadourne. This is the Haut Médoc, a district of about forty-five kilometres in length, and from eight to twenty kilometres in width. Its general feature is that of a vast plain, falling somewhat towards the Gironde. Its soil is gravel, or rolled quartz or flint, covering a subsoil which is sometimes clayey, but most frequently formed of sand, or of sand which by an infiltration of hydrated iron oxyde has been concreted partly into a soft, friable, pudding stone, partly into a very hard rock-like material, both being known under the name of the *alios.* This variation of the soil causes a great variety in its products, so that the best and most inferior wines grow frequently side by side. As the vines are the same, and their cultivation identical, the soil alone can explain the difference, but the special conditions of this difference are as yet wrapt in mystery.

VINES CULTIVATED IN THE MÉDOC.

The vines cultivated in the Médoc are not many in number, but the names by which they are designated in various communities are very numerous. Happily there are at Bordeaux men of science actively engaged to unravel this confusion. Foremost among them is M. Boucherot, proprietor of the estate of Carbonieux. For a long time he has cultivated all the best known vines of France and other countries, has maintained a collection of synonymous plants, and experimented in his vast vineyard with all the special methods of cultivation usual in the Gironde. He has not only used the results to his own advantage, but allowed everybody to profit by his observations.

The most common vine is the Carbenet Sauvignon.[1] This vine is also termed *Petite Vidure* in the neighbourhood of Bordeaux. Its canes have nodes at frequent intervals; its leaves are small, rather thick, more long than broad, with five lobes separated by deeply cut sinuses, and strongly toothed at the margin. Their upper side is rugged, and of a light green colour; their lower side is slightly woolly. The blossom is not very easily spoiled by cold weather. The bunch of grapes is of less than middle size, pyramidal, longish, generally bearing two somewhat detached wings. The berries are small, of even size, bluish black, very bloomy, with a thin husk. They are very juicy, and have not the sweet astringent taste of the Burgundy grape, but a more acidulous, refreshing, and most agreeable taste, giving the impression, says Bronner, as if one had the Bordeaux wine already in one's mouth. The surname of Sauvignon is derived from the similarity of its leaf and wood to the vine of that name, which will be mentioned lower down. It is the best and most fertile of all the fine black grapes of the Gironde, ripens the earliest, and spoils the last. It is the

[1] "Carbenet" is the word as spelled by Guyot, but Rendu spells it "cabernet." We are inclined to consider "carbenet" the commonest spelling, and add that the *b* of the name is pronounced so softly by the Girondais as to resemble an *m*. The German author Bronner, therefore, collecting his information in the Gironde itself, writes the name "Carmenet."

most esteemed in the great growths of Pauillac, Saint-Julien, and Margaux; it makes up five-eighths of the plantations of Lafitte, Mouton, Latour, Léoville, Margaux, Rozan, &c. It grows particularly well in the heavy soils mixed with much sand and clay. It is regular in its production, but its product, like that of all the best vines, is never abundant; it carries all grapes to an equal degree of maturity at the same time, without showing on the same stalk black, red, and green grapes. It yields wine of a fine colour, full of delicacy, and possessing great bouquet. The wine during the first years is a little harsh, and in order to acquire its perfection must be kept four years in the wood and two years in bottle. But under these circumstances, if it be of a good year, it keeps exceedingly well, increases in delicacy and bouquet up to its fifteenth year, and keeps its qualities up to the twentieth. After that it loses its soft fulness and becomes drier. The Carbenet Sauvignon stands to the great wines of the Médoc in the same relation as the Pineau or Noirien to the great wines of the Côte d'Or; as the Riessling to the great wines of the Rheingau; they would not exist without it.

The second in importance amongst the vines of the Gironde is the *Franc Carbenet* (or *carbenet gris*), a variety of the former. The nodes of the canes are more distant from each other than in the former; the leaves are more wide than long, and dark green above, but otherwise like those of the Carbenet Sauvignon. The petals of its flower do not fall at blooming time like those of other vines, but open at the top, and form a kind of monk's hood over the ovary. The bunch is much like that of the Carbenet Sauvignon, but has smaller berries. This variety prospers in lighter soil (*graves douces*) better than in heavy. Its wine may be described in the same words as that of the first variety.

The *Merlot* (or *gros doux*) has a fine bunch of grapes above the middle size, of pyramidal form, and winged; the grapes are a little flabby, bluish black, and with a thick husk. The Merlot cannot bear drought, and grows best on moist inclines, or so-called *graves fraiches en côteaux*. Its grape ripens a few days before that of the Carbenets, and when once ripe it easily becomes rotten. Its wine is lighter and earlier ready than that of the Carbenet, and has much less bouquet and juiciness (*sève*) than the latter; it also wants body and durability, but its great property is to be soft and tender.

Paguierre states that the Merlot has its name from *merle* (a thrush), because this bird was a particular friend of the grapes of this vine.

The *Malbec* bears many names in the Gironde, amongst them Noir de Pressac, Gourdoux, Estrangey, Côt rouge, Pied de Perdrix. In Central Germany it is known as "Blue James," or "Jacobin." The vine is an abundant producer, and thrives in consistent soils, but also in the gravelly soils if they are not too lean. Its grape is very precocious, very sweet and tasty, much inclined to rottenness when once ripe, and gives a light wine without qualities, particularly when grown on fat land. This explains why this vine is not much grown in the great situations of the Médoc; it is only allowed in the low grounds, and its grape is admitted only as material for second-rate wines.

Count Odart ascribes to the wine made from this grape purity, a dark colour, and much body. This property, says the great œnologist, enables the wine-merchants to mix this wine with white wine, and thus to impart to it the spirit which it wants, without thereby conferring particular advantage on themselves or damaging the consumer. The variety with red grapes and red stalklets is the "Pied de Perdrix." There also exists a variety with green berries and stalklets. In its general character the Malbec is closely related to the Pineau of Burgundy, and in systematic classifications is always placed by its side.

The *Verdot* is a vine of subordinate importance so far as the Médoc is concerned, where it only occurs as an auxiliary. But in the "Palus" or marshes it becomes the vine of first importance. The wines of Queyries and Montferrand owe their reputation to this vine. Its leaves are distinguished from those of the other varieties here cultivated, by showing three or five lobes, of which the middle one is prolonged to a point. Their upper sides are rugged, the lower woolly. The grapes are small, soft, uneven, round, reddish black, strongly bloomed, with a thin skin, and an acidulous taste. They ripen late. The Verdot prospers the better, the moister the subsoil of the land on which it grows. As it is the latest ripening grape of all in the Médoc, it is only planted in good positions. Its wine has much juiciness, fulness, and vinosity, and combines well with that of the Carbenet; it gives durability to wines with which it is mixed. The Verdot is therefore found amongst the best growths of the Médoc, in Pauillac, Saint-Julien, and Margaux.

The *Cruchinet*, sometimes also specified as *Cruchinet rouge*, has a large bunch with closely packed grapes; the latter are a little elongated. Its fine-lobed leaf is but slightly woolly. It gives a remarkably agreeable bouquet to wine, and for this reason has for some years been multiplied at Château Lafitte.

The *Carmenère* is cultivated at Margaux and Cantenac. It thrives in light sandy soil, and is not injured by drought. It shoots early in spring, and yields a sweet and tasty grape, with black skins. Its wine has more body and colour than that of the Carbenet Sauvignon. The Carmenère develops its full bearing powers only seven or eight years after plantation, and is never very fertile. It yields only six barriques of wine to the hectare, where the Carbenet Sauvignon would yield twelve. It is therefore cultivated solely for its peculiar qualities in particular situations, and not rarely mixed with the Cruchinet. The mixed wine of these two plants is of excellent quality.

These, then, are the principal vines of the Médoc yielding wines of quality. There are of course other vines cultivated in mediocre situations, the only quality of which is fertility. Thus the *Brasac*, with small grape; the *Mareye*, with very large grape; and the *Enrachet*, with sour grapes and red woolly leaves, have all some advantages in certain localities.

MODES OF CULTIVATING THE SOIL AND VINE IN THE MÉDOC.

Before a piece of land is planted with the vine, it is always grubbed and levelled, so as to cause the water to fall in a certain direction. In the marshy land, or palus, ditches are also cut round the vineyards, and systematic drainage with tile-tubes is effected. In parts where the alios is not far from the surface it is broken up, however hard it may be, but if it lies deeper than one metre, it is left untouched. It has long been a disputed question whether the alios was penetrable by water or not, and whether in the latter case it ought not to be removed from, or at least frequently pierced, in every vineyard where it presents itself. The opinion of viticulturists is now in favour of a slight permeability of the alios. The ordinary depth of the grubbing is sixty centimetres, or two feet English. The soil is then allowed to become settled, and after a good rain planting is commenced. For each cane a hole is made with an iron rod, the cane inserted, and surrounded with a little loose sand; or the canes are laid into holes dug with the bident hoe or *pioche*. In the second year, if certain canes have failed, they are replaced by rooted canes or *barbeaux*. The part of the cane above ground has two eyes, and is fixed to a stake with an osier tie. The vines of the same line stand at a distance of one metre ten centimetres from each other; the lines are one metre apart. The hectare generally carries nine thousand vines. In the first year the land of the vineyard is turned and weeded six times, in the second year only four times. In this year the young vine is cut back upon two or three eyes. In the third year the vine-dresser commences to form the two arms which constitute the peculiarity of the Médoc cultivation. In addition to the stake close to its stem called "tutor" (*carasson*), a second stake is placed equidistant between each two vines, and their tops are united horizontally by a single line of lath (*latte*). To these the vines are fixed in the manner illustrated by Figs. 49 and 50.

These represent the vines at various ages as they appear after the spring dressing. The whole of the vines of the Haut Médoc are thus cultivated.

As the vines begin to bear they are manured; at the foot of each vine a hole is made, filled with manure, consisting mostly of rotten stable-dung, so called *consommé*, and again covered with earth. Every fifty vines receive a cubic metre of dung. When the foot of the vine is uncovered, the vine-dresser cuts off the coronal, day, or dew-roots close to the stem.

The pruning of the vines begins in the first days of November, and is completed in January. In the fifth year

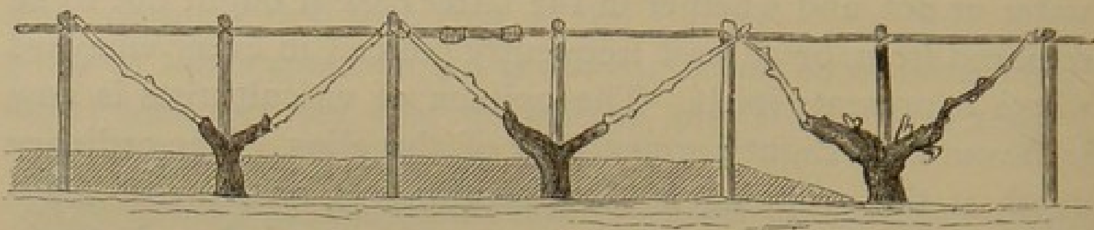


FIG. 49.—Normally trained vines of the Haut Médoc: A, 4 years old; B, 8 years old; C, 16 years old.

each vine has its two arms as represented above; and now begins the process called *taille à l'aste.*[1] The "aste" is the strongest cane of the one year's wood grown from the

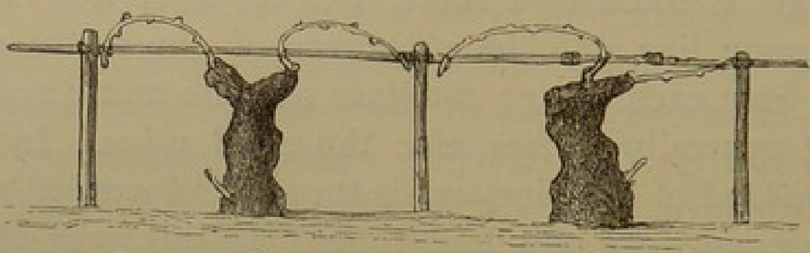


FIG. 50.—Normally trained vines of the Haut Médoc: D, 40 years old; E, 90 years old.

stationary arm, cut to a length of from six to eight eyes. The astes of young vines up to ten years are fixed diagonally with their end to the lath, as shown in the figures above. But, when the vines are higher than fifteen centimetres with their arms from the ground, which always is the case after they are twelve years old, the astes have to be bent in an

[1] This word in the Médoc has the specific meaning of "fruit-branch," and reminds us of the German *Ast,* a branch in general. There are several words referring to the cultivation of the vine, derived from German or Saxon roots, used in the Gironde, which do not occur in any other part of France. Possibly, the transplantation of vines from the Moselle to the Bordelais, related by Ausonius, was the occasion of the transfer of these terms.

arch open towards the ground, as shown in the engravings of the two old vines. By the side of the aste is left a stump (*tiret*) of two eyes, intended to produce the canes from which the next year's aste is selected. Each arm, therefore, carries one aste and one two-eyed stump,—that is to say, a viticultural element, as defined on p. 68; each vine therefore has two astes and two tirets: now as each fruit-bearing branch may carry from six to eight bunches, and each stump three to four, each vine may bear from eighteen to twenty-four bunches of grapes.

The vine-dressers frequently preserve on the old wood short stumps of new wood (*côts*), in order to be able to replace an entire arm, or an aste and tiret, in case it should have failed in growth or died off entirely. This practice also affords the means for lowering the vine, and bringing at least one of its arms nearer to the ground, in case it should have risen so high as to be inconvenient in the dressing and injurious to the fruit.

It has frequently been tried to adopt the low cultivation of the Rheingau; but as it ruined the vines and yielded but small grapes, all such attempts have been abandoned.

Although the principle of cutting on the aste and tiret pervades the entire Médoc, there are yet certain modifications required by each of the varieties of vines which we have above considered. The Carbenet gris, or Franc carbenet, planted in suitable soil, will bear eight eyes to the aste. If it is cut shorter, it runs into wood and sheds its blossoms. The Carbenet Sauvignon, on the other hand, which is less strong, should not have more than six or seven eyes to the aste. This latter vine is the best test of the ability of the vine-dresser. For, if cut too much for bearing, it is quickly exhausted; and if cut too short, it yields very poor vintages. Both these varieties of vine grow, with care, new wood on the old stem during the first ten years, and, in good soil, even later: when the arms are to be renewed lower down, it is effected on one side first, and after the establishment of a new arm, aste, tiret and all, the other arm is similarly lowered. The Malbec and Merlot are also cut upon aste, tiret, and côt, but there are one or two tirets left in addition, which produce a few more grapes. The Verdot is cut shorter, and does not frequently exhibit such long arms as the other varieties. Whatever the modifications required by vine, age, and soil, the rules for cutting the vine, which govern the entire practice in the Médoc, may be summed up as follows:—1. The vine is to be established upon a vigorous root and stem, and nothing is to be neglected to perfect its general shape. 2. The vine is to carry two arms, the bifurcation of which is not to be higher from the ground, after the moveable part of this ground is removed from the foot of the vine (*la vigne étant déchaussée*), than fifteen centimetres. This brings the bifurcation just above

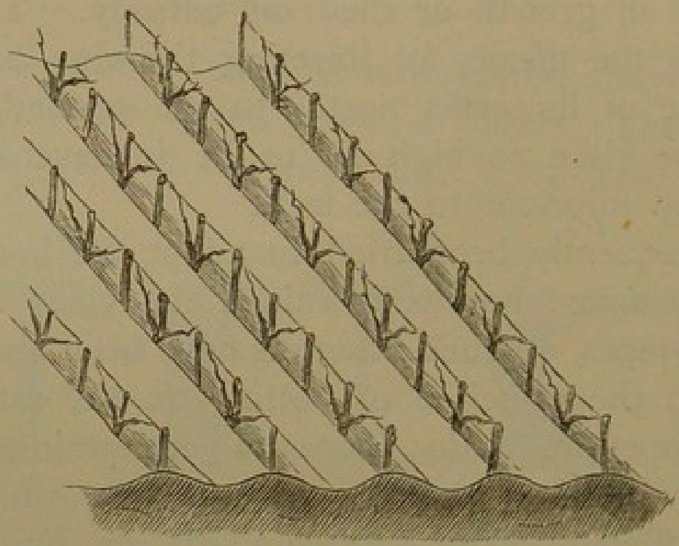


FIG. 51.—Normal cultivation of the Haut Médoc.

ground when the stem is earthed (*rechaussée*). 3. The arms are to be kept as low as possible, and never to reach above the lath, which is from forty-five to fifty centimetres above the bifurcation—say sixty centimetres above the unearthed ground. The vine is to be cut back frequently; for, as the vine-dressers say, the shortening of the vine regenerates it. 4. Each arm is to be provided with a wine-branch bearing a sufficient number of eyes, and future wine-branches are to be prospected from well-placed stumps, or côts and tirets.

The low cultivation in the Médoc is originally not a matter of choice, whatever may be its advantages. Hitherto, the turning of the soil in the vineyards of the Médoc has been effected by means of a plough, which was drawn through the lines by two large oxen yoked together. The yoke consequently had to pass over the lines of vines, each ox finding just room in the free space between two lines. The lines therefore had to be kept as low as possible, and the oxen had to be selected as high-legged and elephantine as possible. The plough was of so heavy and clumsy a form, that one ox or horse could not have drawn it through the land. The plough therefore demanded two oxen: these had to be yoked across the *latte*, and the latte had to be kept low in order to let the yoke pass.

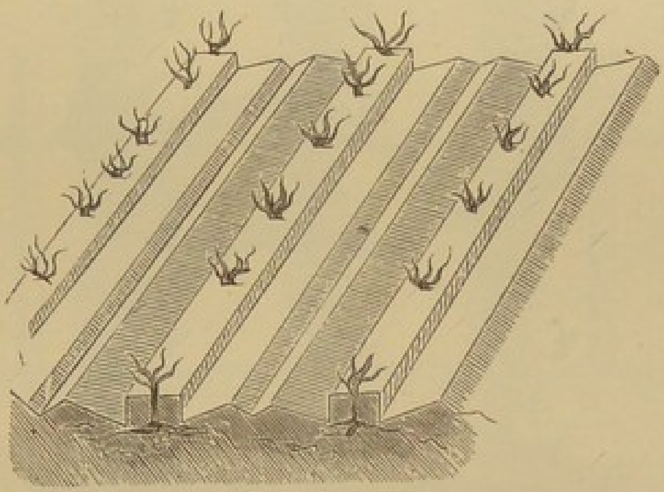


FIG. 52.—Lines of vines, the earth in course of being dressed with the plough. Département de la Haute Garonne.

The greater perfection of agricultural instruments in general, however, has also had its effect upon the ploughs of the Médoc. The new ploughs of M. Portal, of Moux, and of Goëthals and Scawinsky, of Giscours, are effective, light instruments, drawn by one ox or horse, and will soon have displaced the old instruments. Then the viticulturists will no doubt give to the stake nearest to the trunk of the vine greater, perhaps double, its present length, in order to be able better to fasten the growing canes, which are to form the bearing branches of the succeeding year. They should adopt as much of the fashion of Sauternes regarding erect fastenings, as the vine-dressers of this latter district would do well to learn from the Médoc the practice of lateral fastening of the young shoots. Such an assimilation of practice would be beneficial to both, and, by generally increasing the amount of produce, be beneficial to the consumer.

After the vines are cut, and the spaliers are put up, or, as the case may be, repaired (they are never taken down except when decay necessitates their replacement), the vines and bearing branches are tied with osiers to the stakes. While the pruning is done by men, these latter operations are

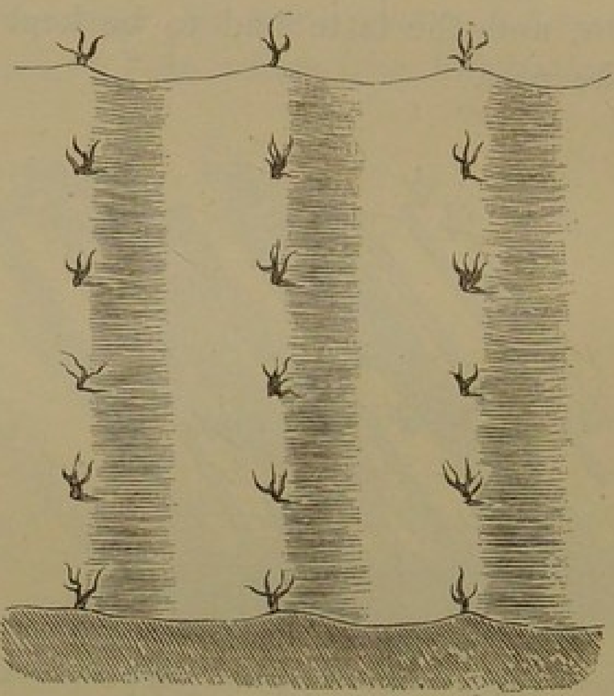


FIG. 53.—Vines in lines on ridges, the earth being thrown up around the stems (*chaussées*). Département de la Haute Garonne.

generally performed by women. The binding is termed the *pliage*, because in this process the necessary bending of the aste is simultaneously effected, and is the most obvious effect, towards which the binding is only a means.

In case a vine dies out, one of the longest and strongest canes of the next vine is sunk into the earth without being separated from its stem, and formed into a young vine. This layer is separated after the second or third year.

The vineyards are ploughed for the first time early in March. By this operation the earth is removed from both sides of the foot of the vines, and thrown up into ridges running in the middle of the open spaces between the rows. The mounting of the plough which effects this is called *cabat.* Labourers with hoes remove the bands of earth which remain between the vines underneath the latte: this operation is termed *renverser les cavaillons.* The entire operation is known as that of opening the vine (*ouvrir la vigne*).

The second ploughing is performed in April, with the mounting called *courbe.* This pushes the earth back to the foot of the vine, and transforms the intervals between the rows into furrows, through which the rain-water can flow easily towards the terminal ditches. In May, the vines are again un-

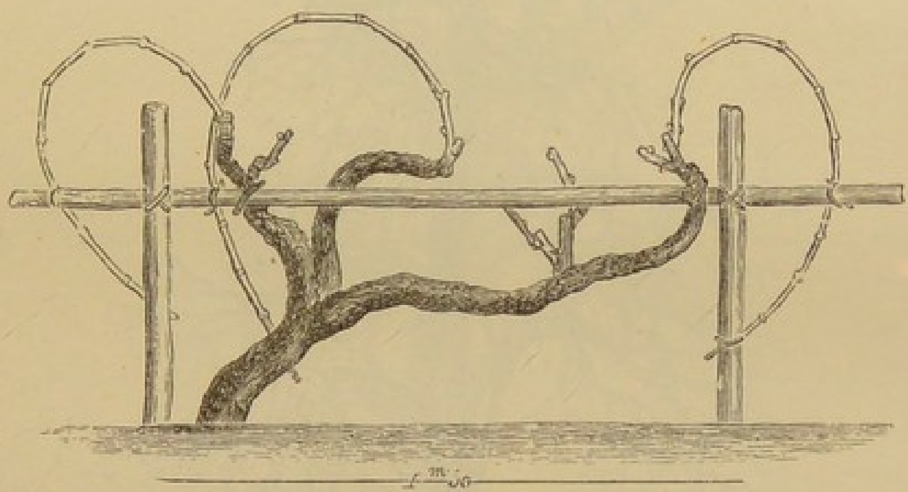


FIG. 54—A vine upwards of 100 years of age, as trained at Malines, near Verteillac. In the year following the one in which this sketch was made it produced seventy-three bunches of grapes Département de la Dordogne.

earthed as at the first ploughing, and at a last fourth ploughing they are again covered as at the second. This last operation is determined by the degree of development of the grapes. The berries must be well formed, and then the operation is looked upon as very advantageous; it generally takes place at the end of July or beginning of August; all weeds, if not completely ploughed in, are at the same time carefully removed.

The manuring of the vines is effected by putting manure into the furrow opened by the cabat, and covering it with earth by means of the courbe.

The blossom time of the vine in the Médoc is very regularly the period from the 10th to the 15th of June. Immediately after it is passed, the superfluous shoots are cut off by means of a knife (a practice by which this operation of the *ébourgonnement* in the Médoc is distinguished from that in most other departments where the suckers are mostly broken off). Each variety of vine demands special treatment at this period. The Carbenets bear but slight shortening and cutting out of the suckers. A stump should always be left, as after a certain age their old wood does not any longer form new shoots. But the Malbec and Merlot, and particularly the

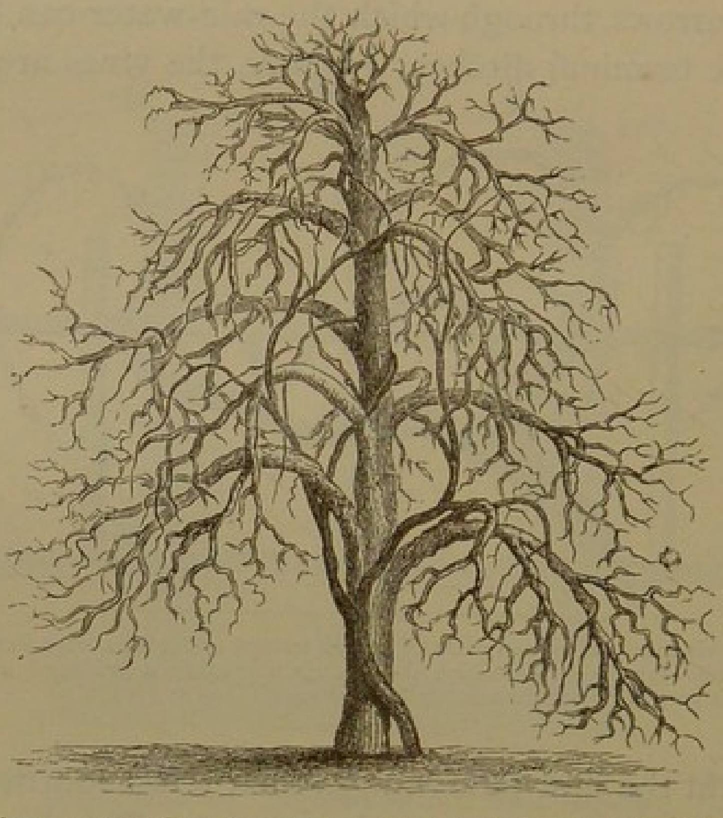


FIG. 55. Vine supported by a walnut-tree, as seen at Celles, canton of Montagries, arrondissement of Ribérac, département de la Dordogne.

Verdot, put forth new shoots from the old wood every year, and may therefore be deprived of all suckers.

The shortening or cutting of the green canes, called *rognage*, is only effected once towards the approach of the vintage. Its object is to hasten the maturation of the grapes by compelling the sap to go particularly towards the fruit. In this respect the tolerance of the vines seems reversed; the Carbenets bear much cutting, while the Merlot, Malbec, and Verdot do not. There may be some shortening at the time of ploughing to make room for men and animals, or at the vintage time to give better access to the vintagers. Sometimes also the vine-dressers cut branches merely for the purpose of feeding their cattle with them.

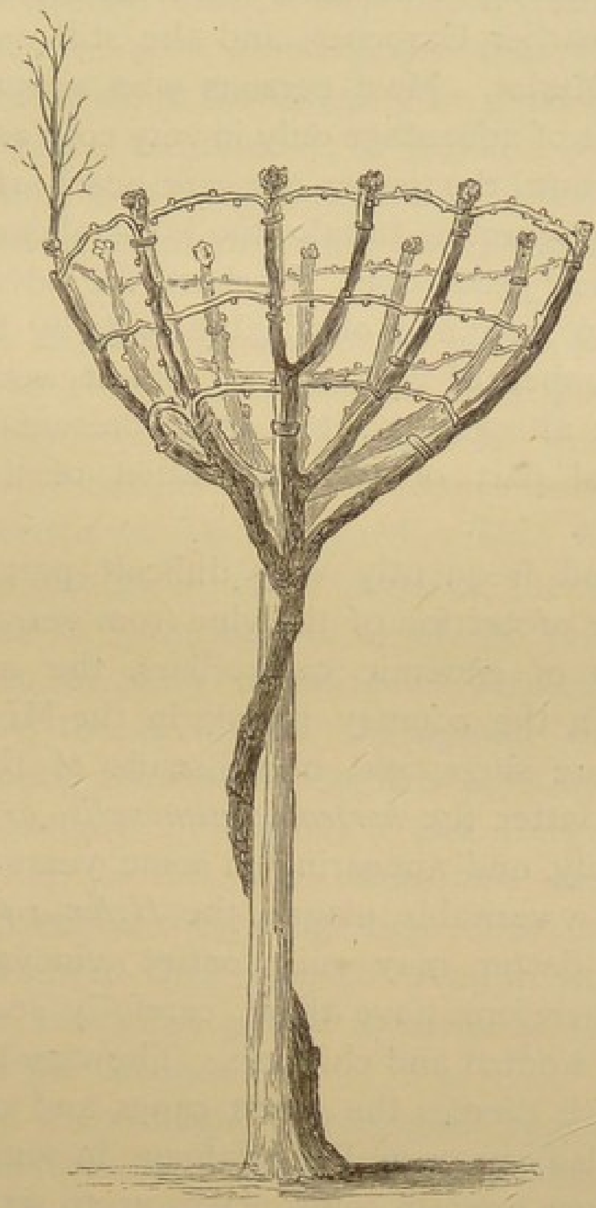


FIG. 56.—Vine trained upon a tree called "goblet-shape," as seen at St. Gaudens, near Toulouse, département de la Haute Garonne.

It is a common practice in the Médoc to remove the leaves from the vine when the grapes are ripening, with a view of exposing them to the sun for the purpose of greater maturation. But this practice, which may do good in exceptional, well-selected, and properly-conducted instances, is, on the whole, ruinous to the quality of the wine. Some unleaf the vine all at once, without that gradual thinning which enables the grape to prepare itself for the direct rays of the sun, from which hitherto it has been hidden. Others take the leaves from all varieties of vines at the same time, whether they are late or early, strong or delicate, and treat the late Verdot the same as the earlier Carbenet, and the still more precocious Malbec and Merlot. Most persons who adopt this practice forget that it is of advantage only in very cold and wet seasons, and then not until the grapes are very nearly ripe. They are moreover so ignorant as to take the leaf-stalks off and deprive the eyes of their protection. In short, the advantages of this practice are so rare, and obtainable only by the observance of such a number of precautions, that it would be well to discontinue it altogether. It is, as at present performed, the most irrational part of the cultivation of the vine in the whole Gironde.

Another and frequently very difficult part of viticulture consists in the protection of the vine from vermin. There are several kinds of endemic caterpillars, the *altise*, and the *attelabe*, which the country people in the Médoc call *crabe*. Then there are slugs, and many snails of the helix tribe; amongst the latter the *hortensis*, *nemoralis*, *arbustorum*; but most commonly, and appearing in some years in hundreds of thousands as a veritable plague, the *Helix aspersa*, or *Escargeot*. These latter may ruin entire vineyards, and the proprietors therefore have them carefully searched for and destroyed by women and children. The vine-beetle (*Curculio Bacchus*), which pierces the green canes and causes them to pine or die, also causes no little damage in some years.

The vine lives long, in some places up to sixty and seventy years, while in others its vitality is quickly exhausted, so that Margaux and Cantenac have to replant every twenty or thirty years. This seems to depend upon conditions of the soil, which cause the early decay of the main roots of the lowest ring. It is said that layers of sand, through which waters pass horizontally, are the commonest cause of the early extinction of the plants. The cultivators therefore have given to such sand the name of the *dead sand*.

THE VINTAGE IN THE MÉDOC.

The vintage in the great growths of the Médoc is about a fortnight earlier than that in any other vineyards for red wine of the Gironde, and a month earlier than the vintage in the districts of the white Sauternes. In good years it commences on the 20th of September; in middling years, between September 25 and October 1. Years in which the vintage can only take place in the first fortnight of October are said to be bad.

Amongst the acquisitions of liberty which the Girondese conquered in the great revolution was this, that every proprietor should have the right to collect his grapes when he pleased, and should not be subjected to any restraint or compulsion in reference to his vineyard. This natural right, which has been lost in so many parts of the world by the oppression either of governments or of the much more intolerable tyranny of petty democracies termed communes, was restored by the revolution throughout the whole of France. But during the restoration, this right was again lost in many parts, partially or entirely; and Burgundy, for example, is smarting to this day under this most silly and injurious of restrictions, the vintage-ban. But the Girondese resisted, and preserved their liberty. And in this liberty we recognize one of the most potent agencies of the perfection of vinification in the Gironde.

At the time of the vintage in prosperous years, great numbers of labourers flock to the Médoc from all the surrounding departments,—the Charente, Landes, the Pyrenees, and from the Blayadais and Libournais. Not rarely they arrive in shiploads by the Gironde, and are of the poorest classes. They are led in gangs by agents (termed *commandants*), who defray the expenses of transport of the labourers, and bargain with the proprietors. The pay which these vintagers receive differs a little, according to the years and demand, as determined by other agricultural labours. The women and children receive fifty centimes (5*d.*) per day and their food and night's quarter;

the porters, or carriers of baskets, &c., receive one franc (10*d.*) per day, with food and night's quarter; the labourers, who work in the press-house, get a slight gratuity in addition to the wages of porters.

The details of the labour of the vintage are performed with the following organization:—The women and children cut the bunches, and immediately remove all green, rotten, or otherwise spoiled grapes. To every gang cutting a range of vines there is a superintendent (*rangeur*), who takes the full baskets (*paniers*) from the cutters, and at the end of the range gives them to a basket-emptier (*vide-paniers*): this official puts the grapes into a large pail, called *baste;* when a baste is full, a porter (of whom there are two to every eight ranges of vines) carries it to the waggon, where the two attendants of the waggon and of the vat fixed upon it empty the contents into the vat (*douil* or *douillat*), and stamp them down. A commandant directs the whole of the operations, from the cutting to the moment when the vat, being full, is carted by oxen, under the guidance of an oxherd, to the *cuvier*, or place where the grapes are converted into wine.

This press-house mostly contains the presses (*pressoirs* or *fouloirs*) on the one side, and the vats or cuves on the other. The presses are of three kinds, each serving for a separate part of the operation; and therefore each press-house contains, as a rule, a set of three presses. But the instruments serving for the first and second operations are only improperly called presses. They are receptacles in which the grapes are taken from the stalks and trodden and crushed by men's feet. The presses are mostly of wood, but there are some also of stone, such as those of Lafitte, Calon Ségur, and Château Margaux. The best Médoc presses are of two forms, which we have represented on pp. 108, 109, and the first is a cylindrical or barrel-press, and the second one is a square press.

This latter has advantages over the former in this, that any quantity of grapes, large or small, may be pressed at any time. But if the vintager desires to add to pulp already in the press, he only needs add a layer of boards all round, and so raise the height of the press and increase its capacity. On the other hand, as the pulp is being pressed dry, the upper boards may be removed, and thus give free scope to the levers by which the screw-nut is turned. Some of these presses measure three metres on each side, those of smaller proprietors have one metre a side. They may be fixed or moveable on wheels, so as to be easily transportable to each fermentation vat. In one of the largest establishments we saw two presses which moved backwards and forwards on railways running in front of the two rows of fermentation vats.

The cylindrical presses have from five to six feet diameter, and open in two halves, like the shell of a nut. They are preferred in establishments where there is material enough to fully employ their capacity. Thus we saw at St. Estèphe, on the estate of M. Phelon, two such round presses at work, which during one vintage pressed 800 barriques of wine. The cylindrical presses press more evenly than the square ones, as the extreme parts are equidistant from the active centre of the screw. During the filling in of pulp into these presses, the precaution is observed of laying perforated boards horizontally upon every foot of pulp. The resistance of the pulp is thus subdivided and broken.

The fermentation vats are all of wood, and not of stone, as in Burgundy; or of marble, as in Spain. The larger vats are preferred, as it is said that in them the wine gets more body.

When the oxen-drawn waggon arrives at the press-house, four or five of the vintagers or pressmen empty the contents of the small vats into a large press. Next begins the business of pulling the berries from the stalks. The grapes are thrown with shovels on large square wire nets, and then moved about with the hands until all the berries have fallen through the meshes into the press below. The stalks are then kept apart for a while. When a press is sufficiently filled, a number of men step in and tread the berries with their naked feet. This they do to the sound of music of the clarionette or violin. They dance regular *contre-danses* until the pulp has been trodden through. The pulp is then shovelled upon a heap in the middle of the press, the pressmen dance round it, and at each step throw with uplifted leg a little of the pulp from the heap upon the ring in which they dance. When the heap is quite dispersed the *contre-danses* begin again, and so on until the pulp is perfect. The must is drawn off at intervals and put into the vat.

This method of crushing the berries is fast falling into desuetude, and at the present day half of the proprietors of the Médoc do not crush their grapes at all. The omission produces no difference in the wine, which is of the same quality whether the berries be crushed or not.

The stalks are not cast aside, but either partly or entirely put into the fermentation vat. This is a great mistake, as it causes that astringent taste of the wine which requires years for its mitigation. The power of conservation which the extract of the stalks may possess is now no longer needed, since we have means for quickly maturing wines and securing them against all accidents. We hope, therefore, to see all Bordeaux wine hereafter made upon the method recommended in our general part, to the advantage of both producers and consumers.

The fermentation vats, being thoroughly cleaned and sponged with brandy, are filled with the mixture of juice, stalks, skins, and kernels; each vat if possible the same day, and then left at absolute rest until the wine is formed. The time required for this vinification varies very much according to the quality of the vintage and the temperature of the season; in good years it is not more than four or five days. If the vatting is continued longer, the wine becomes fuller, but loses good taste, softness, and delicacy: these latter qualities are preferred to body in the good parts of the Médoc, where also deep colour is rather avoided; another reason for making the vatting period as short as possible. The time for drawing the wine from the vats is determined by the taste of experienced persons; the must should have lost its sweetness and assumed a vinous flavour: it is then drawn off by means of an instrument called a *griffon* into a large wooden vessel, and is thence transferred by means of cans into the barriques, so that each barrique receives an equal number of cans of each running from each vat; and at the end of the operation all the barriques of the *chais* (or barrel storehouse) contain wine of the same quality. This wine, which runs spontaneously from the vats, and runs clear, is termed the *first wine.* There is also a *second wine* from the grapes which are grown on the estate, but in inferior situations: this possesses strength and soundness, and will sell at about two-thirds of the price of the wine of first choice. The *third wine* is that which is produced from the pulp in the vat, by the agency of the press. The thick wine which runs from the vat after the clear is termed *fond de cuve,* and is used only with second wine. This runs yet off spontaneously, and the pulp is not put into the press before all liquid that will flow off spontaneously is separated. By the pressing of the pulp a very dark "thick" wine is obtained, which is never mixed with first wine. It is most commonly used for mixing with white wine, whereby it loses much of its hardness and alcoholicity; for it is a singular circumstance, that the pulp retains much alcohol mechanically, and that the wine pressed from it is from 3 to 5 per cent. stronger in alcohol than the first wine.

The filling of the wine into the barriques must be completed in three days at the utmost, in order to preserve to the wine all its qualities. The barriques are then closed. During the first month they are filled up (*ouillé*) every four or five days; during the second month every eight days; and subsequently every fortnight, until they are racked. This filling up is always effected with wine of the same quality. The wine is racked three times in the first year; once in January or February, a second time in June, and a third time in September. In subsequent years it is racked but twice. It remains in the barriques for four years before it is put in bottles, and may be drunk when six years old. But in these respects each vintage has its own peculiarities. Thus the wine of 1825, an excellent year, came to perfection only in 1845, while that of 1828 required only seven or eight years; the wines of 1831 were very late, those of 1834 and 1847 precocious. The wines of 1846 were hardly ready ten years later.

In the foregoing we have described the type of the vintage and vinification in the Médoc, and desire yet to mention some of the variations observed in various localities. On estates where great differences in the qualities of the vineyards prevail, the several qualities are collected in vats by themselves, and the wines resulting from them are not mixed. Some proprietors mix the press-wine with the first running and the fonds, because, as they express it, the press-wine feeds the first. We know that it does so by increasing its alcoholicity and its colour.

QUALIFICATION OF THE WINES OF THE MÉDOC.

The Médoc has about 20,000 hectares of vineyards, of which each produces two tonneaux or 18 hectolitres and 24 litres of wine; on an average, the whole Médoc consequently produces about 40,000 tonneaux. Of these, 4,500 are high class wines, another 4,500 are simply fine wines, so that actually only about 9,000 tonneaux, or 82,000 hectolitres of choice wines, are annually produced. The other 31,000 tonneaux, although sold under the name of Médoc wines, are ordinary qualities.

The fine wines of the Médoc—that is, the above 9,000 tonneaux, which we will describe as yielding ten millions of ordinary wine-bottles full of wine—may be arranged in three categories. 1. The classified wines coming from certain vineyards in the arrondissement of Bordeaux and Lesparre. 2. The "citizen" or *bourgeois* wines, which are again subdivided into higher, good, and ordinary citizen, or *bourgeois supérieurs*, *bon bourgeois*, and *bourgeois ordináire*. 3. The "peasants" or *paysans*, or wines of the small proprietors. Whatever the category to which they may belong, all wines of the Médoc are distinguished and easily recognized by certain general characters which exclude all confusion with other wines. They have a certain slight peculiar roughness, are fine, juicy, marrowy in the mouth, and, after having been in bottle some years, they have a very beautiful bouquet. They have moreover this remarkable hygienic quality, that they can be drunk in large quantity without, as the French say, "fatiguing" either head or stomach. In this respect all other wines of France behave differently. The Médoc wines also stand transportation better than any other French wines, and by long sea-voyages are greatly improved.

Classified Growths.—The commerce of Bordeaux recognizes about sixty classified growths. They are enumerated in the work of M. Frank, and may be conveniently subdivided with this author into five great divisions.

First Growths.—Including only the first three growths (*les trois premiers crus*) of the whole Médoc.

Château Margaux.—This estate is the property of a Spanish banker, Aguado Marquis de las Marismas, and produces annually from 100 to 110 tonneaux of wine. As at Johannisberg and Steinberg, a great farm is attached to the wine-producing establishment, on which an enormous number of cattle yield the manure by means of which the vines afterwards luxuriate. The cuvier contains eighteen vats, all in one line; opposite to these there are six pressoirs, all built in stone, upon which the grapes are separated from the stalks and trodden into pulp. The chais or cellar is an enormous hall of great height, the ceiling supported by eighteen columns. Everything here is splendidly arranged, but the vinification is the same as it was fifty or a hundred years ago. The vats are filled up to within a foot of the upper margin, and the contents allowed to ferment open. The chapeau rises, sometimes to the extent of an entire foot, above the margin of the vat; its upper half is always taken off; and no part of it is left that has not a purely vinous smell, without admixture of acetic or putrid odours. No selection is made, and the whole of the vintage of all the vineyards of the estate furnishes but one quality of wine. Notwithstanding, this wine is nearly always the best of the whole Médoc. In good or great years it is absolutely the best, but in middling years Lafitte and Latour are superior to it. As compared to St. Julien and Pauillac, the wine of Château Margaux has more finesse and juiciness, but less body.

The vineyards of the Château are about eighty hectares in extent. Its soil is a grey-coloured, heavy material (*grave*), with a substratum of clayey pudding-stone, often containing sand and veins of iron-oxyde. The principal slopes are towards east and west, but the best part of the vineyards, the Sampeyre, is sloped towards the north and the south, and nevertheless yields the best wine. One-half of the entire surface is planted with the Carbenet Sauvignon.

Château Lafitte is the property of the banking-house Rothschild, and has sixty-seven hectares of vines; its soil is very variable, being a strong *grave* or clay-gravel, with all kinds of slopes, amongst which those towards the north predominate. The subsoil is very uniformly made of quartz (rolled stones mixed with sand and clay). Five-eighths of the vineyard are planted with the Carbenet Sauvignon; the other parts mostly with the Carbenet gris and the Merlot. The wine of Lafitte has all the qualities of the Château Margaux, but lacks its finesse; it has, however, more body and a distinguished taste.

Château Latour.—Proprietors, Messrs. de Coutivron and de Flers. The vineyards have an area of only forty-two hectares. The vines are planted in heavy clay-gravel, with a compact subsoil of much rolled stone. The surface is more regular than that of Lafitte, and inclined uniformly one-half towards the north and the other towards the south. Two-thirds of the vines are Carbenet Sauvignons; there are also Carbenet gris, and the Malbec prevails in the low situations. The wine of this Château has the most body amongst the three great growths of the Médoc, but less finesse and bouquet.

Second, third, and fourth Growths.—These we will enumerate in the approximate order of their quality and value, and state the area of the vineyards as well as the estimated annual produce in hogsheads, in the following list of Classified Wines :—

LIST OF CLASSIFIED GROWTHS OF THE MÉDOC.

(*Showing under the name of each commune the names of the proprietors of vineyards, and the average number of hogsheads of wine annually produced.*)

RED WINES.

First Growths.

		Hects.		Hhds.
Château Lafitte .	Pauillac . .	67	Baron de Rothschild	480 to 600
Château Margaux .	Margaux . .	80	Marquis Aguado . .	400 ,, 440
Château Latour .	Pauillac . .	42	De Beaumont . . / De Courtivron . . / De Flers	280 ,, 360
Haut Brion . . .	Pessac . .	44	Eugène Larrieu . .	400 ,, 480

Second Growths.

		Hects.		Hhds.
Mouton	Pauillac . .	52	Baron de Rothschild	480 to 560
Rauzan Ségla . / ,, Gassies	Margaux . .	51	Cesse. de Castèlpers / Viguerie	280 ,, 300
Léoville	St. Julien .	65	Marquis Lascazes .	320 ,, 400
		30	Baron de Poyféré .	160 ,, 200
		25	Barton	200 ,, 280
Vivens-Durfort . .	Margaux . .	32	De Puységu . . .	120 ,, 140
Gruau-Larose . .	St. Julien .	51	De Bethmann . . / Baron Sarget . . . / Veuve Boisregard .	400 ,, 600
Lascombe . . .	Margaux . .	21	Hue	60 ,, 80
De Brane . . .	Cantenac .	45	Baron de Brane . .	200 ,, 240
Pichon-Longueville	Pauillac . .	50	Baron de Pichon-Longueville.	400 ,, 480
Ducrue-Beaucaillon	St. Julien .	35	Ducru-Ravez . . .	280 ,, 360
Cos-Destournel .	St. Estèphe .	28	Martyns	280 ,, 320
Montrose . . .	Do. . .	—	Dumoulin	400 ,, 480

Third Growths.

		Hects		Hhds.
Kirwan	Cantenac .	24	Ph. Godard . . .	140 to 160
Château d'Issan .	Do. . .	43	Blanchy	200 ,, 280
Lagrange . . .	St. Julien .	122	Count Duchatel . .	480 ,, 600
Langoa	Do. . .	70	Barton	400 ,, 480
Giscours	Labarde . .	45	J. and P. Pescatore	320 ,, 400
St. Escupery . .	Margaux . .	—	Fourcade	100 ,, 120
Boyd	Cantenac .	—	Several proprietors .	120 ,, 140
Palmer	Do. . .	85	E. Pereire	200 ,, 240

THIRD GROWTHS—*continued.*

		Hects.		Hhds.
La Lagune . . .	Ludors . .	36	Piston	120 to 160
Desmirail . . .	Margaux . .	14	Sipierre	80 ,, 100
Dubignon . . .	Do. . .	13	P. Dubignon . . . M. Dubignon . .	60 ,, 80
Calon	St. Estèphe .	55	F. Lestapis . . .	480 ,, 640
Ferrière	Margaux . .	8	Veuve J. Ferrière .	40 ,, 60
Becker	Do. . .	—	Synyderski . . .	16 ,, 20

FOURTH GROWTHS.

		Hects.		Hhds.
St. Pierre	St. Julien .	18 9 9	Bontemps-Dubarry . Veuve Roullett . . Veuve Galloupeau .	100 to 140 100 ,, 140
Talbot	Do. . .	69	Marquis d'Aux . .	280 ,, 320
Duluc	Do. . .	60	Veuve Duluc . . .	320 ,, 360
Duhart	Pauillac . .	—	Castéja	160 ,, 200
Pouget-Lascale .	Cantenac .	—	Izan	40 ,, 60
Pouget	Do. . .	11	De Chavaille . . .	48 ,, 60
Carnet	St. Laurent .	52	De Luètkens . . .	400 ,, 480
Rochet	St. Estèphe .	22	VeuveL.deCamarsac	120 ,, 160
Ch. de Beychevelle	St. Julien .	40	P. F. Guestier, jun..	400 ,, 480
Le Prieuré . . .	Cantenac .	—	Rosset	100 ,, 120
De Thermes . .	Margaux . .	—	O. Sollberg . . .	160 ,, 180
Canet	Pauillac . .	67	De Poutet	400 ,, 480
Batailley	Do. . .	34	J. F. Guestier . .	240 ,, 320
Grand-Puy . . .	Do. . .	52	F. Lacoste	200 ,, 240
Artigues-Arnaud .	Do. . .	—	Duroy	320 ,, 400
Lynch	Do. . .	—	Jurine	280 ,, 320
Lynch-Moussas .	Do. . .	—	Vasquez	120 ,, 160
Dauzats	Labarde . .	—	Wiebrok	200 ,, 240
D'Armailhacq . .	Pauillac . .	—	D'Armailhacq . .	400 ,, 480
Le Tertre . . .	Arsac . . .	—	C. Henry	240 ,, 280
Haut-Bages . . .	Pauillac . .	—	Libéral	60 ,, 80
Pedescleaux . .	Do. . .	—	Pedescleaux . . .	100 ,, 120
Coutenceau . . .	St. Laurent .	—	B. Devez	80 ,, 120
Camensac . . .	Do. .	—	Popp	120 ,, 160
Cas-Labary . . .	St. Estèphe .	—	Martyns	160 ,, 200
Clerc-Milon . .	Pauillac . .	—	Clerc	80 ,, 120
Croizet-Bages . .	Do. . .	—	P. Clavé	200 ,, 240
Cantemerle . . .	Macau . .	91	De Villeneuve-Durfort.	480 ,, 520

The yield of the whole of these growths may be estimated to be about five millions of bottles. The excess of 220,000 bottles which might be calculated from the sum of the numbers of tonneaux raised, would be quite absorbed by filling up, racking, and loss in bottling operations and trans-mission. When these five millions of bottles are distributed over the consumers of the whole world, it becomes apparent how small a quantity each can obtain, and how enormous must be the substitutions which the trade of Bordeaux and other places makes of unclassed and indeed of any kind of wine, whether from Bordeaux or other parts of France, for Médoc.

PRICES OF THE MÉDOC WINES.

The study of the prices of the Médoc wines is interesting because there is a singular relation between the prices of the various growths. This relation remained the same in almost all years, good or bad, the key-note always being the prices of the three first growths. In favourable years the second growth obtained 300 francs less than the first; the third 300 francs less than the second, and so on, so that the wines of the fifth class obtained just one-half of the price of the first class, which we here assume to have been 2,400 francs the tonneau at the time of the first spring racking. But the wines of Château Margaux and Latour have now for many years been sold by contract at a fixed price of 2,100 francs the tonneau, whether the vintage was good or bad, and have not entered the general market at all; consequently the trade was reduced to Lafitte as a regulator of the prices of the other classes. But owing to the contraction of the market, the prices of Lafitte became enormously high, and the prices of the lower classes could no longer be regulated by its standard with the scale formerly in use. This change has greatly improved the value of the second-class wines, but has had no corresponding effect on wines of the fifth class, which now sell only at half the price of the second class, instead of as formerly at half the price of the first-class growths.

In estimating the average prices of the Médoc wines, the prices obtained in great years should be eliminated; these are exceptional, as the following will show:—In 1844 a quantity of Lafitte was sold from the castle at 4,500 frs. the tonneau; Haut Brion at 3,000 frs.; Mouton, 2,500 frs.; Lagrange, 1,900 frs.; Kirwan, 1850 frs.; Giscours, 1,800 frs.;

Langoa Barton, 1,600 frs. These are maximum prices, occurring once in a century. The second growths, which rose to 2,500 frs. in 1844, do not fetch more than from 1,200 to 1,400 frs. the tonneau in ordinary years; the wines of the third class fetch ordinarily from 800 to 1,000 frs., the fourth class little less; the wines of the fifth class in ordinary years do not exceed 600 or 700 frs.

The same applies to other wines of the Médoc: the *bourgeois supérieurs* in 1844 were sold at from 1,000 to 1,200 frs.; the *bons bourgeois ordinaires* at from 700 to 800 frs. The *paysans* of Pauillac and Margaux obtain prices which are about one-half of the wines of the fifth class, but in 1844 they were sold at prices rising to 600 and 650 frs.; in ordinary years their price is about 300 frs. From these considerations we derive the following scale of prices for average growths :—

1st class	2,000 to 5,000	francs per tonneau.
2nd class	1,200 to 1,400	,, ,,
3rd class	800 to 900	,, ,,
4th class	700 to 900	,, ,,
5th class	600 to 700	,, ,,
Bourgeois sup. ...	400 to 500	,, ,,
Do. ordinaires ...	350 to 400	,, ,,
Paysans	300 to 325	,, ,,

The prices of the latter wines are curiously alike in all villages of the Médoc. As the travelling brokers cross the country, a uniformity of price is established, which greatly astonishes those who do not know the machinery by which it is brought about.

MODE OF EFFECTING SALES IN THE MÉDOC.

Sales are mostly effected through brokers, who know the districts and all their varieties and accidents: they visit the cellars, taste the wines, and classify them. It is not uncommon for them to raise or reduce the rank of a certain growth according to the care which has been bestowed upon the cultivation of the vine, and upon vinification. The merchants of Bordeaux mostly rely upon the judgment of these brokers, but the growers are often dissatisfied with it, and complain of their arbitrary estimates. Ultimately the growers cannot hold out, and submit with grumbling to the guides of the world's commerce.

CONSUMPTION OF MÉDOC WINES.

The first-class wines are scarcely ever drunk in France, but go to foreign parts. England is the principal consumer of the best qualities of Médoc; lower classes go to Holland, Russia, and particularly the north of Germany.

The Médoc wines going to England are sometimes—and were formerly more frequently than at present—prepared, specially before exportation, by being mixed with wine from the east or centre of France, or with brandy. The fine wines are mixed with red Hermitage, in order to please better the palates accustomed to ports and other strong alcoholic drinks. Such wines obtain thereby a warmth and spirituosity which is by no means natural to them, and lose much of their juicy softness and finesse. Persons of knowledge recognize such wines at once, and put them into their proper places. But numbers of wealthy consumers know no better, and drink the mixture as genuine and pure. The amount of mixing carried on at Bordeaux is incredible; for its exports are twelve times as great as the production of the entire Médoc, and one-half of these exports sells as Bordeaux wine, so that it is quite fair to assume that the Gironde wine is multiplied several times by the addition or substitution of other wines of France, the Gard furnishing alcohol and colour, the wheat-land of the Mâconnais producing the acidity, and all other parts of France the special subordinate needed ingredients.

We have ourselves witnessed on the quay at Bordeaux the addition of brandy to red wines of ordinary quality destined for exportation to England. This admixture is by no means uncommon, but it never reaches the amount common with Portuguese red wines. Bordeaux wine rarely exceeds 10 per cent. in its alcoholicity; while ports have from 19 to 20 per cent., or double the strength of Bordeaux wines. The exporters allege that this addition is made to suit the English palate, and is by no means required as a preservative of the wine. We have therefore here the elements of agreement ready for a solution. For the consumers need only say that they desire to have the wine without the adventitious brandy; and the exporters, if they have spoken truly, will at once leave it out.

STATISTICS OF VITICULTURAL PROPERTY AND PRODUCTION OF THE MÉDOC.

(*Showing under the name of each commune the names of the proprietors of vineyards, and the average number of hogsheads of wine annually produced.*)

BLANQUEFORT.

RED WINES.

		Hhds.			Hhds.
Dulamon	Albrecht	360 to 440	Mataplan	Delisse	80 to 100
Fleurennes	Tatset	320 ,, 360	Arboudaut	Ferry (Antoine)	48 ,, 72
Château Dillon	Seignouret	480 ,, 600		Ferry (Jean)	48 ,, 72
				Meymat (Pierre)	48 ,, 72
Château St. Ahon	De Matha	160 ,, 200	Laubarède	Paillotte	60 ,, 80
Olivier	Aviragnet	120 ,, 160	Réaud	Caboy	48 ,, 60
Linas	Clossman	120 ,, 160	Lagoublaye	D'Albessard	40 ,, 60
Montheuilh	St. Quentin	120 ,, 160	Somos	Veuve Tastet	40 ,, 60
Cholet	Béchade	120 ,, 160	Canteret	Bidou	40 ,, 48
Château Deluz	Delisse	200 ,, 240	Malajème	Baziadoliq	40 ,, 60
Curgan	Lafon	100 ,, 120	Vendure	Tastet	40 ,, 60
Clapot	Chauvot	200 ,, 240	Cambon	Larrieu	40 ,, 60
Maurian	Dégrange-Touzin.	80 ,, 100	Corne	Mme. Rols	32 ,, 40
			Muratel	De Pichon	24 ,, 40
			Taveau	Marrauld	20 ,, 40
Château Breillan	Portal	120 ,, 160	Bounard	Héritiers Bounard.	20 ,, 40
Palu Baubens	Grimal	80 ,, 100			
Dasvin Bélair	Béchade	60 ,, 80	Badin	Ve. Badin	32 ,, 40
Palu de la Ialle	Portal	80 ,, 100	Several small owners, some of whom produce from 20 to 40 hhds.		900 ,, 1000
Duportail	Courregolles	60 ,, 80			
Frichon	Ginoulhiac	60 ,, 80			
Salesse	Do.				

WHITE WINES.

		Hhds.			Hhds.
Château Dillon	Seignouret	80 to 100	Vendure	Tastet	20 to 32
Dulamon	Albrecht	60 ,, 80			
Montheuil	Wuillaume	60 ,, 80	Château St. Ahon	De Matha	20 ,, 40
Lagoublaye	D'Albessard	20 ,, 32	Cholet	Béchade	16 ,, 24

LUDON.

RED WINES.

		Hhds.			Hhds.
Château d'Agassac . .	Richier . . .	600 to 800	Village de Lafon	Bethmann . .	60 to 72
Paloumey . .	Aguirre Vegoa Uribaren.	160 ,, 200	La Lagune . .	Jouny . . .	48 ,, 60
La Lagune . .	Mme. Veuve Joffrey.	120 ,, 160	Darche . . .	Labouthe . .	48 ,, 60
Darche . . .	Eymond . . .	120 ,, 160	Lataste Canteloup.	Les héritiers Constantin.	40 ,, 48
Au bourg . .	Veuve de Bacalan.	80 ,, 120	Do. . . .	De St. Georges	24 ,, 32
Darche . . .	Les héritiers Larausa.	72 ,, 88	Darche . . .	Doumeret . .	24 ,, 32
Do. . . .	Larausa Mathieu dit Maçon	60 ,, 80	Do. . . .	Trevié . . .	24 ,, 32
Bisaudun . .	Ferrussac de Gravol.	60 ,, 80	Village de Lafon	Devignes . .	24 ,, 32
			Do. . . .	Veuve Larausa	24 ,, 32
			Do. . . .	Lestage . . .	24 ,, 32
			Au bourg . .	Vignolles . .	20 ,, 24
			Do. . .	Andraut . . .	20 ,, 24
			Patoumey . .	Goubineau . .	20 ,, 24

A few small proprietors growing 16 hhds. and under.

LE TAILLAN.

		Hhds.			Hhds.
Château du Taillan.	Viscount de Barrelli.	600 to 800	Germignan . .	Pal. Bidon . .	60 to 80
Domaine de Busaquet . .	Veuve Lapenne	320 ,, 400	Do. . . .	Serveau . . .	40 ,, 60
Germignan . .	Gustave Curé .	160 ,, 200	Lagorce . . .	Veuve Abadie.	40 ,, 60
L'Allemagne .	Veuve Janesse.	120 ,, 140	L'Allemagne .	G. Salzedo . .	40 ,, 48
Lagorce . . .	Veuve Igonet .	100 ,, 120	Au bourg . .	C. Guestier. .	32 ,, 72
Do. . . .	F. Ginoulhiac .	100 ,, 120	Germignan . .	Montalieu . .	32 ,, 40
Germignan . .	Reglade . . .	80 ,, 100	Au bourg . .	G. Salzedo . .	32 ,, 40
			Do. . . .	Barbefer. . .	24 ,, 40
			Do. . . .	Ginoulhiac . .	24 ,, 40

LE PIAN.

		Hhds.			Hhds.
Maurian . . .	Vergne-Dupuch	240 to 320	Lamouroux .	De Maignol .	48 to 72
Château de Sénéjac . . .	J. Causse . .	320 ,, 400	Do. . . .	Sisters of Charity.	40 ,, 48
Basterot - Malleret . . .	Sicard . . .	160 ,, 240	Moulin de Soubiran . .	L. Tardieu . .	40 ,, 48
Gaube, Genissan	Nicolas . . .	60 ,, 80	Louens . . .	Several small growers.	60 ,, 80
De Bacalan .	Veuve de Bacalan.	60 ,, 80	Poujeaur . .	Do. . . .	80 ,, 120
Lamouroux .	Letu Bros. . .	60 ,, 80			

PAREMPUYRE.

GRAVES.

		Hhds.			Hhds.
Château de Parempuyre	De Pichon	80 to 100	Ch. Ségur (formerly)	Gueyrand	72 to 80
Le Vigneau	Veuve Both de Tauzia.	48 ,, 60	Lilot	Veuve Rondeau	32 ,, 40
			L'Ille d'Arés	Destanque	40 ,, 48

PALUS.

		Hhds.			Hhds.
Labouret	Yvoy	200 to 240	Mossac	Lafonta	60 to 80
Cadillac	Boissière	80 ,, 100	Bordes	Veuve Both de Tauzia.	48 ,, 60

ARSAC.

		Hhds.			Hhds.
Le Tertre	C. Henry	240 to 280	Bel-Air	Hosten de Macau.	60 to 72
Château d'Arsac	C. Montmejean	200 ,, 240	Canteloup	Dutruch	48 ,, 64
Brown	Parisian Company.	120 ,, 160	Lambale	Jadouin	40 ,, 48
			Aux Pys	Lambert	40 ,, 48
Baury	Desmirail	120 ,, 160	Montpontet	Chapaz	32 ,, 60
Deyrem et le Poujeaux	Pescatore	80 ,, 100	Ligondra	Dubos	32 ,, 40
			Do.	Blanchard	32 ,, 40
			Montbrison	Feuillebois	20 ,, 24

Eight or ten growers producing from 16 to 24 hhds.

MACAU.

		Hhds.			Hhds.
Cantemerle	Baron de Villeneuve.	480 to 520	Gironville	Duffour-Dubergier.	140 to 160
			La Biche	Vieillard	140 ,, 160
Château de Maucamp	Aguirre Vengoa	240 ,, 280	Terre-Fort	Vieillard	120 ,, 140
La Houringe	Duteau Burk	200 ,, 240	Bern	Dugravier	120 ,, 140
La Pelouse	Betgé-Lagarde.	160 ,, 200	Guitot	Lacouture	100 ,, 120
Château des Trois Moulins	Veuve Duranteau.	160 ,, 200	Bern	De Massip	60 ,, 80
			Moulin de Dumey	Attier, sen.	48 ,, 60
Château de Priban	Chadeuil	160 ,, 200	Rabaud	Attier, jun.	40 ,, 48

A great number of growers, not classified, producing from 8 to 28 hhds.
The Palus of Macau contains some very large estates, and is capable of producing from 4,000 to 6,000 hhds.

LABARDE.

		Hhds.			Hhds.
Giscours	Pescatore	200 to 240	Château Siran	Countess de Lautrec.	160 to 180
Faget	Geneste	180 ,, 200			
Bellegarde	Chevalier de Lynch.	200 ,, 240	Risteau	Dubignon	60 ,, 80
			Deyrem	Capbern	60 ,, 80
Bourgarde	De Lachapelle.	60 ,, 80			

Some small proprietors growing from 2 to 12 hhds., which are sold about one-third cheaper than the *petits bourgeois.*

CANTENAC.

		Hhds.			Hhds.
Château d'Issan	Blanchy	280 to 320	Tour Massac	Jeanfort - Darquié.	60 to 80
Château Brane-Cantenac	Baron de Brane	280 ,, 320	A Jeanfort	Goudat	32 ,, 40
Palmer-Pereire.	E. Pereire	240 ,, 280	Do.	Marian	32 ,, 40
Boys	Grommard	240 ,, 260	Au bourg	Chartron	12 ,, 20
Kirwan	Godard	120 ,, 160	A Jeanfort	Blanchard	16 ,, 24
Martinens	Garnier	120 ,, 160	Au bourg	Guillot	20 ,, 28
Angludet - Legras.	Sundry proprietors	100 ,, 120	Issan	Mariot	24 ,, 32
			Do.	Marie	20 ,, 28
Pouget	De Chevailles	48 ,, 60	Do.	Bacquey	20 ,, 24
Le Prieuré	Pagès	60 ,, 80	Port Aubin (la palus).	Count de Marolles	600 ,, 800
De Pontac	Eyrem	48 ,, 60			
Ganets	De Lassalle	40 ,, 60			

MARGAUX.

		Hhds.			Hhds.
Château Margaux.	Marquis Aguado	400 to 440	Sequin	Héritiers Micau	72 to 80
Rauzan	Count de Castlepert.	220 ,, 240	Dubignon	Dubignon, J.	16 ,, 24
			Do.	Dubignon, P.	60 ,, 72
			Ferrière	P. Ferrière	24 ,, 40
Durfort	Count de Puységur.	160 ,, 200	Dugravey	Dugravey	40 ,, 48
			Lacroix	Eyquem	40 ,, 48
De Therme	Solberg	160 ,, 180	Lascombe	Miss Hue	40 ,, 60
Weltener	Vastapani	160 ,, 180	Cadillon	Cadillon	32 ,, 40
Rauzan Gassies	Chabrier	120 ,, 140	Montpontet	Chapaz	40 ,, 48
Lanoire	Lanoire	120 ,, 140	Seguineau	Duthil	40 ,, 48
La Colonie	Fourcade	100 ,, 120	Do.	Feuillebois	16 ,, 20
L'Abbé Gorse	Veuve de Gorse	100 ,, 120	D'Alesme (Becker)	Sznajderski	16 ,, 20
Desmirail	Cipière	80 ,, 100			
Malescot	Fourcade	72 ,, 80	Ten or twelve smaller growers		320 ,, 360
Danglade	Danglade	60 ,, 80			

SOUSANS.

		Hhds.			Hhds.
Château Paveil	Minvielle	560 to 600	Gd. Sousans	Dayries	100 to 152
Château Latour de Mons	De Lajeard	320 ,, 400	Deyrem	Deyrem, V.	80 ,, 100
Château Bel Air	Marchioness de Pomereu.	200 ,, 240	Van-Beynum	— —	60 ,, 72
Capelle	Vastapani	200 ,, 240	Toujague	Gauteyron, C.	60 ,, 80
Larigaudière	Larigaudière	200 ,, 240	A Marsac	J. Arnaud Douat	60 ,, 72
Seguineau Dayries	Dayries	160 ,, 180	Do.	J. Miqueau	60 ,, 72
Pt. Barbot (formerly)	Zédé	140 ,, 160	Au Maucaillon	R. Maurin	40 ,, 60
Maucaillon	Dupuy	140 ,, 160	A Virefougasse	C. Douat	40 ,, 60
De Gorse	Veuve de Gorse	120 ,, 160	A Marsac	Les héritiers Morin.	40 ,, 48
Rambaud-Siamoy	Holagray	120 ,, 160	Do.	Saintout	40 ,, 48
Au Taillac	Holagray, A.	120 ,, 140	Au bourg	Pérès	40 ,, 48
			A Marsac	Douat	32 ,, 40
			Palus de Meyre	Duffour	32 ,, 40
			Grand Meyre (Palus)	Lanoire	400 ,, 480

AVENSAN.

		Hhds.			Hhds.
Château Citran	Clauzel	1000 to 1200	Bouneau	Perrogon	60 to 80
Marteau	Estèbe	100 ,, 120	Le Pont	Sundry owners.	60 ,, 80
La Cure	Dufresne	100 ,, 120	Belair	Dubos	48 ,, 60
Mallet, Primat, Pelin	Sundry owners	100 ,, 120	Vellegorre	Hauchecorne	40 ,, 48
Romefort	Do.	80 ,, 100	Laprade	Sundry growers	40 ,, 48
Laudire	Do.	80 ,, 100	Au bourg	Métria	32 ,, 40

CASTELNAU.

		Hhds.			Hhds.
Château Mauvesin	Mauvesin	400 to 480	Galan	— —	72 to 80
Château Pommes	Château	280 ,, 320	Jeanty	— —	60 ,, 80
Civaillant	— —	280 ,, 320	Trigaud	— —	60 ,, 80
Bergeron, Pierre	— —	120 ,, 140	Bernadet	— —	48 ,, 60
Goutier Lalande	— —	100 ,, 120	Robin	— —	48 ,, 60
Mrs. Marcou	— —	100 ,, 120	Delarose	— —	40 ,, 48
Duprat	— —	100 ,, 120	Renouil	— —	40 ,, 48
Bacou	— —	100 ,, 120	Robin	Monereau	40 ,, 48
St. Guirons	St. Guirons	80 ,, 100	Dardan	— —	40 ,, 48
Videau	L. Videau	80 ,, 100	Gachet	— —	40 ,, 48
Soret	— —	80 ,, 100	Taudinot	— —	40 ,, 48
Mougès	— —	80 ,, 100	Delhomme	— —	32 ,, 40
			Beaubois	— —	32 ,, 40
			Moreau	— —	24 ,, 32

There are also many smaller proprietors, growing from 800 to 1,200.

MOULIS.

		Hhds.			Hhds.
Château Pougeaud . . .	Castaing-Belisle	360 to 400	Bourg . . .	E. Bergeron .	80 to 100
Château Mauvesin.	Leblanc de Mauvesin .	360 ,, 400	Do. . . .	Bergeron . .	80 ,, 100
Château Duplessis. . .	L. Favre . .	280 ,, 320	Grand Poujeaud	Delhomme . .	80 ,, 100
Ruat	Mrs. Menessier	240 ,, 280	Do. .	Dutruch . . .	80 ,, 100
Grand Poujeaud	J. J. Castaing .	240 ,, 280	Petit Poujeaud	Gaffre-Laune .	80 ,, 100
Gastebois . .	Do. .	200 ,, 240	Bourg . . .	Gaffre . . .	80 ,, 100
Brillette . . .	Duperrier . .	200 ,, 240	Grand Poujeaud	R. Renouil . .	80 ,, 100
Do. . . .	L. Anslients .	160 ,, 200	Médrac . . .	Lescontra - Janasse.	80 ,, 100
Grand Poujeaud	L. Renouil . .	160 ,, 200	Do. . . .	Martin-Richet .	80 ,, 100
Couqueyran .	Carrère	160 ,, 180	Bourg . . .	Hostein . . .	80 ,, 100
Louet au-neuf .	Lamorère, sen.	140 ,, 160	Chaux . . .	A. Hostein . .	80 ,, 100
Do.	Lamorère, jun.	140 ,, 160	Bourg . . .	Mérie . . .	80 ,, 100
Grand Poujeaud	Darquier . .	120 ,, 140	Grand Poujeaud	Robert . . .	80 ,, 100
Do. .	Franquet . .	120 ,, 140	Couqueyran .	Martin . . .	60 ,, 80
Petit Poujeaud	Viaud . . .	120 ,, 140	Do. .	P. Martin . .	60 ,, 80
Do. .	R. Richebon .	120 ,, 140	Grand Poujeaud	Raymond - Ramounille.	60 ,, 80
Maliney . . .	A. Hugon . .	120 ,, 140	Do. .	Marie . . .	60 ,, 80
Grand Poujeaud	Ducasse . . .	100 ,, 120	Petit Poujeaud	R. Hugon . .	60 ,, 80
Couqueyran .	D. Brun . . .	100 ,, 120	Couqueyran .	Hauchecorne .	60 ,, 80
Brillette . . .	Mrs. Menessier	80 ,, 100	Médrac . . .	B. Raymond .	40 ,, 60
Petit Poujeaud	Savignac . .	80 ,, 100	Do. . . .	Lescontra-Lannelier.	60 ,, 80

LISTRAC.

		Hhds.			Hhds.
Roullet . . .	Dupré . . .	320 to 400	Peyrelevade .	Berdon . . .	240 to 320
Lestage . . .	St. Guirons .	320 ,, 400	Veyrin . . .	Hostin . . .	60 ,, 80
Hosten . . .	B. de St. Afrique.	240 ,, 320	Do. . . .	Virac	80 ,, 100
Laburthe . .	Do. . .	240 ,, 320	Au bourg de Listrac . .	Richebon . .	80 ,, 100
Fonreau . . .	Leblanc de Mauvesin.	400 ,, 600	Do. . .	Raymond . .	60 ,, 80
			Do. . .	Do. . .	80 ,, 104
Bourgade . .	Bourgade . .	100 ,, 120	Do. . .	Do. . .	40 ,, 48
Bounet . . .	Bounet . . .	160 ,, 200	Baudan . . .	Lambert . .	48 ,, 60
Clark . . .	Abiet . . .	240 ,, 280	Jautard . . .	Cazeaux . .	40 ,, 48

ARCINS.

		Hhds.			Hhds.
Château d'Arcins . . .	Subercazeaux .	600 to 640	Cru de Tramond . . .	Baron . . .	72 to 80
Malescot . .	Do. .	240 ,, 280	Au bourg . .	Bosq, Bros. .	72 ,, 80
Laroc de Porges	C. Fauché . .	240 ,, 280	Do. . .	Lartique . .	60 ,, 80
Crû de Barreyres.	Dup. de Larsan.	160 ,, 200	Do. . .	Baziadolit, Bros.	72 ,, 80
			Do. . .	Robert . . .	60 ,, 72
Au bourg . .	P. Renouil . .	80 ,, 100	Do. . .	Pinet	60 ,, 72

LAMARQUE.

		Hhds.			Hhds.
Pigneguy-Mercadier . .	Pigneguy . .	240 to 280	Picaille . . .	Hostein . . .	40 to 48
Bergeron . .	De la Neufville and Darmana	400 ,, 520	Au bourg . .	Pineau . . .	32 ,, 40
Château Lamarque . .	Count de Fumel	160 ,, 200	Do. . .	Soleillan . .	32 ,, 40
Le Cartillon .	Bethmann . .	320 ,, 360	Picaille . . .	Chazeau . . .	32 ,, 40
Lafon, au bourg	B. Capdeville .	60 ,, 80	Rue des Milous	Baziadoliq . .	68 ,, 80
N. do. .	J. Rosset . .	100 ,, 120	Au bourg . .	Grillet . . .	32 ,, 40
N. do. .	Meyre . . .	60 ,, 80	Calénotes . .	Carasset . . .	40 ,, 48
Château Malecasse . . .	Renouil . . .	320 ,, 360	Au bourg . .	Boulle . . .	24 ,, 32
Do. . .	Veuve Bergeron	100 ,, 120	Do. . .	Bergeon . . .	40 ,, 48
Do. . .	Saintout . .	80 ,, 100	Do. . .	Renouil . . .	40 ,, 48
Do. . .	Barbié, sen. .	80 ,, 100	Rue des Milous	Sahuc . . .	24 ,, 32
Do. . .	Barbié . . .	48 ,, 60	Do. . .	Graneau . .	24 ,, 32
Do. . .	Bacquey-Titon	48 ,, 60	Do. . .	Valentin . .	24 ,, 32
Do. . .	Monties . . .	40 ,, 48	Do. . .	Nouchet . .	24 ,, 32
Calénotes . .	Meyre . . .	40 ,, 48	Au bourg . .	J. Bergeron .	24 ,, 32
Do. . .	Boué	40 ,, 48	Calénotes . .	Veuve Bose .	24 ,, 32
			Rue des Milous	Blanc . . .	24 ,, 28
			Do. . .	J. Arnaud . .	24 ,, 28
			Au bourg . .	Segonnes . .	20 ,, 24
			Do. . .	Veuve Grillet .	20 ,, 24

About ten other proprietors, producing together from 100 to 120 hhds.

CUSSAC.

		Hhds.			Hhds.
Beaumont . .	Bonin . . .	480 to 520	A Gaston . .	Héritiers Lambert.	60 to 72
St. Gemme . .	Phelan . . .	400 ,, 450	A Peylande .	Delhomme-Berlingue.	60 ,, 72
Lanessan . .	L. Delbos . .	320 ,, 340	A Coudot . .	Audouin . .	56 ,, 64
Bernones . .	Boué	200 ,, 220	Au bourg . .	Veuve Teychenau.	56 ,, 64
Lamothes .	De Bergeron .	160 ,, 180	Do. . .	R. Paté . . .	48 ,, 60
Raux	Bonin . . .	160 ,, 180	Do. . .	Badoux-Fraizot	48 ,, 60
Romefort . .	Badoux . . .	120 ,, 140	A Goua . . .	Bensac . . .	48 ,, 60
A Mouneins .	Mars	120 ,, 140	Do. . . .	Lestage . . .	48 ,, 60
Do. . . .	Giraud . . .	120 ,, 140	A Lauga . .	Saintout . . .	48 ,, 60
Do. . . .	Héritiers Bensac.	96 ,, 112	A Mouneins .	Lartigue . .	48 ,, 60
Beaumont . .	Guestier . .	80 ,, 100	Do. . .	Bosq-Guillemot	48 ,, 60
Salva . . .	De Camino .	80 ,, 100	A Coste . .	Daubos . . .	48 ,, 60
A Mouneins .	Renouil . . .	80 ,, 100	A Coudot . .	Grenier . . .	48 ,, 60
Becamil . . .	Ducru . . .	80 ,, 100	Do. . .	P. Hosten . .	48 ,, 60
A Martin . .	Pagan . . .	80 ,, 100	Do. . .	Lartigue . .	48 ,, 60
A Gaston . .	Eyrem-Vital .	80 ,, 100	Au bourg . .	Lassaubade .	40 ,, 48
A Mouneins .	Bosq	72 ,, 80	Do. . .	Duvergé . .	40 ,, 48
Becamil . . .	Dubos . . .	72 ,, 80	A Arnausan .	B. Dubos . .	40 ,, 48
A Jacquet . .	Veuve Miot .	64 ,, 72	A Coste . . .	Saintout, jun. .	40 ,, 48
Au bourg . .	VeuveBousquet	60 ,, 72			
A Coudot . .	Delhomme . .	60 ,, 72			

ST. JULIEN DE REIGNAC.

		Hhds.			Hhds.
Lagrange	Count Duchatel	600 to 800	Au bourg	Saux	80 to 100
Léoville	Marquis de Las-cases.	400 ,, 600	Beychevelle	Lagarde	40 ,, 60
Langoa	Barton	400 ,, 600	Au bourg	Bonnin	48 ,, 60
Léoville	Barton	200 ,, 240	Hortevie	P. Roux	48 ,, 60
Beaucaillou	Ducru	320 ,, 400	Au bourg	Delor	32 ,, 40
Beychevelle	F. Gueslier, jun.	560 ,, 600	Do.	F. Davia	32 ,, 40
Bourdieu	Veuve Duluc	400 ,, 560	Do.	Métie	28 ,, 32
Gruau Larose	Héritiers des Bon. Sarget, Bethman, and Veuve Bois-régard.	400 ,, 600	Do.	Montpontet	24 ,, 32
			Do.	E. Reynard.	24 ,, 32
			Do.	Méric	24 ,, 32
			Beychevelle	Héritiers F. Legarde	28 ,, 32
Talbot	Count d'Aux	280 ,, 400	Do.	Bacquey	24 ,, 28
Léoville	Bon. de Poyféré	160 ,, 240	Hortevie	Bernadet	24 ,, 28
Beychevelle	De Bedout	240 ,, 280	Beychevelle	Déjean	20 ,, 28
St. Pierre	Bontemps-Dubary.	140 ,, 200	Au bourg	P. Bibeyran	20 ,, 28
Do.	Veuve Rouillet	72 ,, 100	Do.	Veuve Blancan	20 ,, 24
Do.	Veuve Galoupeau.	72 ,, 100	Do.	P. Martin	20 ,, 24
Au bourg	Bertrand	100 ,, 140	Beychevelle	P. Lahens	24 ,, 28
Do.	J. Marian	80 ,, 100	Do.	Berthon	140 ,, 180
Beychevelle	Vignallet	80 ,, 100	— —	Cadillon-Labarbe.	160 ,, 200
Au bourg	Jattin	60 ,, 80	Beychevelle	Mitroche	28 ,, 32
Do.	Veuve Mondon	80 ,, 100	— —	Sainton	48 ,, 60
Hortevie	Morin frères ainés.	72 ,, 100	Beychevelle	Martin	24 ,, 28
			La Bridane	Gautier	16 ,, 24

PAUILLAC AND ST. LAMBERT.

		Hhds.			Hhds.
Château Lafitte	Rothschild	400 to 600	Pauillac	Constant	200 to 280
Château Latour	De Beaumont	280 ,, 360	Do.	Pédesclaux	100 ,, 120
Mouton	— —	320 ,, 360	Do.	Lachaufrad	100 ,, 120
A St. Lambert.	De Pichon-Longueville.	320 ,, 360	Do.	Liberal	60 ,, 80
			Do.	Héritiers Veuve Castéja.	60 ,, 80
A Canet	De Pontet	440 ,, 600			
Mouton	D'Armailhacq	400 ,, 480	Do.	J. Desse	100 ,, 120
A Bages	S. Jurine	280 ,, 320	Au Pouyalet	Clerc	60 ,, 80
Moussas	Vasquez	200 ,, 240	St. Lambert	Croiset	32 ,, 40
A St. Lambert	P. Desse	240 ,, 320	Do.	Veuve Daubos.	60 ,, 80
A do.	Weltener	80 ,, 120	Do.	Veuve Brunet	48 ,, 60
A Batailley	D. Guestier	200 ,, 240	Do.	Veuve Croiset	56 ,, 72
A Pauillac	Héritiers Ducasse.	320 ,, 400	Do.	P. Roux	40 ,, 52
			Pauillac	Escaraguel	80 ,, 100
Milon	Castéja	400 ,, 440	St. Lambert	J. Eynard	32 ,, 40
Au Grand Puy	F. Lacoste	440 ,, 480	Do.	Despagne	32 ,, 40
Bages	Calvé	200 ,, 240	Mousset	J. Morange	32 ,, 40
Au Pouyalet	J. Martin	120 ,, 160	St. Lambert	Lamena	32 ,, 40
St. Lambert	Ferchaud	200 ,, 240	Pouyalet	P. Maney	48 ,, 60

PAUILLAC AND ST. LAMBERT—*continued.*

		Hhds.			Hhds.
St. Lambert .	P. Raymond .	32 to 40	Bages . . .	Pouyalet . .	40 to 48
Do. . . .	P. Martin . .	32 ,, 40	Do. . . .	Alaire . . .	64 ,, 88
Au Pouyalet .	P. Arnaud . .	40 ,, 56	Do. . . .	Daubos . . .	48 ,, 64
Do. . . .	Garrabey . .	32 ,, 40	St. Lambert .	Caula . . .	60 ,, 80
Bages . . .	Ardilley . . .	32 ,, 40	Do. . . .	P. Lamena . .	60 ,, 80
Milon . . .	Lagarde . . .	44 ,, 56	Do. . . .	Veuve Lamena	80 ,, 96
Anceilan . .	Eymerie . .	40 ,, 52	Bages . . .	Veuve Cholet .	80 ,, 100
Do. . . .	Moudon . . .	48 ,, 60	Pauillac . . .	Claverie . . .	100 ,, 120
Mousset . . .	Mathé . . .	60 ,, 80	Do. . . .	Moreau . . .	80 ,, 100
Do. . . .	Renyeard . .	40 ,, 52	Padarnac . .	Bichon . . .	80 ,, 100
Do. . . .	Veuve Desse .	100 ,, 120	Pauillac . . .	Moreau . . .	32 ,, 40
Do. . . .	Gratian . . .	32 ,, 40	Do. . . .	Gaillard . . .	32 ,, 40
Do. . . .	Ribeau . . .	56 ,, 72	Do. . . .	Bounivet . .	32 ,, 44
Do. . . .	Mége	40 ,, 48	Milon . . .	Hostein . . .	60 ,, 80
Artigères . .	Chevery . . .	48 ,, 60	Pouillac . . .	Rabère . . .	60 ,, 80
Do. . . .	Ardilley . . .	60 ,, 80	Do. . . .	Veuve Duprat .	32 ,, 40
Do. . . .	Brossard . .	40 ,, 48	Do. . . .	L. Desse . .	32 ,, 40
Bages . . .	Veuve Bichon .	80 ,, 100			

ST. ESTÈPHE.

		Hhds.			Hhds.
Cos-Destournel	Martyns .	400 to 480	Marbuset . .	Plaignard . .	60 to 80
Cos-Labory .	Martyns .	200 ,, 240	Do. . . .	Veuve Campet	60 ,, 80
Pomis . . .	Martyns .	280 ,, 320	Blanquet . .	Andron . . .	100 ,, 120
Montrose . .	Dumoulin . .	280 ,, 320	Leyssac & Marbuset.	Les héritiers Mondon .	120 ,, 160
Calon . . .	Lestapis . .	480 ,, 640			
Rochet . . .	Lafon de Camarsac.	160 ,, 200	Marbuset . .	Les héritiers Martin.	120 ,, 160
Lalande . . .	Tronquoy . .	320 ,, 400	Do. . .	J. Seguin . .	120 ,, 160
Le Bosq . .	DeCamiran, sen	160 ,, 200	Leyssac . . .	Seguin . . .	160 ,, 200
Morin, à St. Corbian . .	L. de Camiran	280 ,, 320	Do. . .	Hostin, dit Faton.	120 ,, 160
Couput . . .	Couput . . .	320 ,, 360	Au bourg . .	Les héritiers Bernard.	160 ,, 200
Pez	De Tarteyron .	280 ,, 320			
Croc	Merman . .	160 ,, 200	Do. . .	Hostin . . .	60 ,, 80
Canteloup . .	Cazeau . . .	280 ,, 320	Leyssac . . .	Teyssonneau .	80 ,, 100
Ségur and Garamey . .			Germain . .	Razeau . . .	80 ,, 100
	Phelan . . .	800 ,, 1000	Cos	Fauchey . .	60 ,, 80
Houissant . .	Bernard . . .	140 ,, 160	Marbuset . .	Etchevevery .	40 ,, 48
Les Ormes . .	Southard-Hostein.	160 ,, 240	Lureteyre . .	Figeron . . .	80 ,, 120
			Do. . .	Grazillon . .	60 ,, 80
Fond-Petit . .	Hostin, dit Faton.	200 ,, 240	Canteloup . .	Bernard . .	60 ,, 80
			Aillan . . .	Bernard, dit Moulet.	60 ,, 80
Meyney . . .	Luetkens . .	600 ,, 800			
Leyssac . . .	Bernard . . .	320 ,, 360	Canteloup . .	Deloude . .	40 ,, 60
Lahaye . . .	Asmus . . .	160 ,, 200	Marbuset . .	Vilain . . .	48 ,, 60
Au bourg . .	Gasqueton . .	280 ,, 320	Do. . .	Desplats . .	40 ,, 48
Carcasset . .	Martin . . .	320 ,, 400	Au bourg . .	Desse . . .	140 ,, 160
Leyssac . . .	Bonie . . .	240 ,, 280	Do. . .	Ducasse . . .	48 ,, 60
Ladouys . .	Barre . . .	200 ,, 240	St. Corbian .	Blanchereau .	48 ,, 60
Au bourg . .	Bert	160 ,, 200	Do. . .	Boyer . . .	80 ,, 100
Marbuset . .	Chambert . .	80 ,, 100	Marbuset . .	Bichon . . .	40 ,, 60
Canteloup . .	Bouillaud . .	48 ,, 60	Leyssac . . .	Prevosteau . .	60 ,, 72
German . . .	Fatou . . .	60 ,, 80	Blanquet . .	Bernard . . .	60 ,, 80

ST. SEURIN DE CADOURNE.

		Hhds.			Hhds.
Senillac . . .	Coiffard . .	520 to 600	Le Mont . .	Rousseau . .	80 to 100
Doyac . . .	Chabaunes . .	400 ,, 500	Au bourg . .	Seilhan . . .	60 ,, 80
Coufran . . .	De Verthamon	400 ,, 440	Cadourne . .	Nouet . . .	72 ,, 100
Verdignan . .	De Parouty .	400 ,, 440	Le Mont . .	Macé . . .	60 ,, 80
Le Tralle . .	Figerou . . .	320 ,, 400	Lestage . . .	Léraud . . .	60 ,, 72
Le Mont . .	Figerou, sen. .	320 ,, 400	Do. . . .	Gombeau . .	60 ,, 72
Charmail . .	Louvet de Paty	280 ,, 320	Au bourg . .	Sarnac . . .	60 ,, 72
Bel-Orme . .	Veuve Tron-quoy.	240 ,, 280	Do. . .	Drouineau . .	60 ,, 72
			Lestage . . .	Dissendier . .	40 ,, 60
Au bourg . .	Rigon . . .	240 ,, 280	La Grange . .	Martin . . .	40 ,, 60
Ducasse . . .	Chomel . . .	200 ,, 240	Marque . . .	B. Figerou . .	40 ,, 60
Grandis . . .	A. Andron . .	200 ,, 240	Le Villa. . .	Laneuve . .	40 ,, 60
Au bourg . .	Figerou . . .	200 ,, 240	Do. . . .	Lussac . . .	40 ,, 60
Muret . . .	Duthil . . .	160 ,, 200	Do. . . .	Grazillon . .	32 ,, 48
Verdus . . .	Boyer . . .	160 ,, 200	Lestage . . .	Simon . . .	32 ,, 48
Lousteau-Neuf	Pereyra . . .	120 ,, 160	Do. . . .	Bosc	32 ,, 48
Sociando . .	Veuve Mallet .	140 ,, 160	La Grange . .	Cocuraud . .	32 ,, 48
Plaisance . .	J. Andron . .	100 ,, 120	Lestage . . .	Andron . . .	32 ,, 48
Pabeau . . .	Pomés . . .	80 ,, 120	Troupian . .	Bouillaud . .	40 ,, 48
Au bourg . .	Hay	80 ,, 120			

ST. LAURENT.

		Hhds.			Hhds.
La Tour de Carnet . .	Luetkens . .	400 to 480	Maderan . .	Clerc . . .	80 to 100
			Marcillan . .	Dupré . . .	80 ,, 100
Belgrave . .	Devès . . .	240 ,, 280	Verrière . .	Verrière . .	40 ,, 60
Perganson . .	E. Lahens . .	360 ,, 400	Maurens . .	Maurens . .	40 ,, 60
Camensac . .	Popp . . .	240 ,, 280	S. Bichon . .	S. Bichon . .	40 ,, 60
Barateau . .	Veron . . .	280 ,, 320	Séjourné . .	Séjourné . .	40 ,, 60
Ballac . . .	Grimail . . .	160 ,, 200	Rionnet . . .	Tisseuil . . .	40 ,, 60
Mascard . .	P. Lahens . .	120 ,, 160	HéritiersGraves	Chaulet . . .	40 ,, 60
Le Galan . .	Les héritiers Guillot.	160 ,, 200	Nadeau . . .	Petit	40 ,, 60
			Fourton . . .	Veuve Guilhem	40 ,, 60
Cache . . .	Pieck . . .	100 ,, 120	Teyssonneau .	Teyssonneau .	32 ,, 40
Caronne . .	Ferchaud . .	100 ,, 120	Mourau . . .	Mourau . . .	32 ,, 40
Seujean . . .	Devès . . .	100 ,, 120	Viaut . . .	Veuve Viaut .	32 ,, 40
Marcillanet .	Bichon . . .	80 ,, 100	Vidal . . .	Vidal . . .	32 ,, 40
De Larose . .	De Larose . .	100 ,, 120	Martin . . .	Veuve Martin .	32 ,, 40
Saintout . .	Saintout . .	60 ,, 80	Sarrotte . . .	Veuve Sarrotte	32 ,, 40

Fifty peasants produce about 12 to 24 hhds.

ST. SAUVEUR.

		Hhds.			Hhds.
Fonpiqueyre	Bernet and Ducasse.	240 ,, 280	Tontesteau . .	Seurin . . .	64 to 72
Liversan .		160 ,, 200	Cassanac . .	Ve. Bernard .	48 ,, 60
Tourteran . .	Le Guénédal .	240 ,, 280	La Naude . .	Sundry small growers.	40 ,, 48
Peyrabon . .	Labat . . .	240 ,, 280			
Madiac . . .	Vasquez . .	200 ,, 240	Fournas . .	Héritiers Pascal	32 ,, 40
Hourtin . .	Duroy . . .	200 ,, 240	Do. . .	HéritiersManey	—
La Batisse . .	Héritiers Cavaignac.	160 ,, 180	Guérin . . .	Villa, dit Maussais.	—

ST. SAUVEUR—*continued.*

Guérin . . .	Gaillard . .	—	Le bourg de St. Sauveur.	Andron . . .	—
Escarjean . .	Hostein . . .	—	Do. . .	Héritiers Blanchard.	—
Do. . .	Maney . . .	—	Laborde . .	Héritiers Laborde.	—
Do. . .	Tiffon . . .	—	Labrousse . .	Bernard . . .	—
Do. . .	Héritiers Tiffon	—	Do. . .	Maney . . .	—
Do. . .	Pie	—	Do. . .	Seignoret . .	—
Le bourg de St. Sauveur.	Eyssan . . .	—			
Do. . .	Delille . . .	—			

Sundry small growers, producing from 8 to 20 hhds.

CISSAC.

		Hhds.			Hhds.
Château du Breuil . .	Baron du Breuil	320 to 400	Vilambits . .	C. Balquerie .	120 to 160
Larrivaux . .	Count du Hamel.	320 ,, 400	Abiet (au bourg)	Abiet . . .	80 ,, 120
Martigny (au bourg) . .	Martigny . .	320 ,, 400	Courrégeolles (au bourg) .	Courrégeolles .	80 ,, 120
Anteillan . .	Lefort . . .	240 ,, 280	Teyssonneau (au Luc) . . .	Teyssonneau .	80 ,, 120
Lamothe . .	Dumousseau .	160 ,, 200	Prévot (au Luc)	Prévot . . .	48 ,, 64

VERTHEUIL.

		Hhds.			Hhds.
Abbaye de Vertheuil . .	Skinner . . .	720 to 800	Au Meynieu .	Cazal Contessouze.	60 to 80
Beyzac . . .	Wüstenberg .	600 ,, 720	A Coutelin .	Blanchard, sen.	60 ,, 80
Picourneau . .	Malvezin . .	160 ,, 200	Au Bourdieu .	Blanchard, jun.	60 ,, 80
Lugagnac . .	Clauzet . . .	160 ,, 200	A la Gravière .	Couerbe . .	48 ,, 72
Au bourg . .	Constant . .	100 ,, 120	A Goua . . .	Monneins . .	48 ,, 72
Au Souley . .	Gauran . . .	100 ,, 120	A Lugagnac .	Roux . . .	48 ,, 72
Do. . .	Grenier . . .	100 ,, 120	A Lille . . .	Mondon . .	40 ,, 48
Au bâtiment .	Begot . . .	80 ,, 100	Do. . . .	Raymond . .	40 ,, 48
Au bourg . .	Millet . . .	80 ,, 100	Au bourg . .	Valleau . . .	40 ,, 48
A Nodris . .	Baron de Miolis	60 ,, 80	Do. . .	Duret . . .	32 ,, 48

ST. GERMAIN D'ESTEUIL.

		Hhds.			Hhds.
Château Levran	Bn. du Perrier de Larsan.	800 to 1000	Barbannes . .	De Verthamon	80 to 100
			Cantegril . .	Colombe . .	80 ,, 100
Château Bries Caillou . .	Do. . . .	400 ,, 480	Artiguillon . .	Delille . . .	48 ,, 60
			A Barbehire .	Meynieu . .	140 ,, 160
Château Castera	De Verthamon	300 ,, 320	Au bourg . .	Durand . . .	48 ,, 60
Au bourg . .	A. Charron .	180 ,, 200	Artiguillon . .	Dubosq . . .	48 ,, 72
Latour . . .	De Lambert .	80 ,, 100	A Fogères . .	Arnaud . . .	32 ,, 40

ST. CHRISTOLY ET COUQUEQUES.

	Hhds.		Hhds.
Guittard (cru St. Bounet)	300 to 360	Grach, jun.	48 to 60
Martial	240 ,, 280	Veuve Courbes	48 ,, 60
Lardilley (cru St. Bounet)	240 ,, 280	Guiraud, P.	40 ,, 60
Veuve Lussac	160 ,, 200	Alibert	40 ,, 60
Guiraud	160 ,, 200	Pelau	40 ,, 52
Laforest	160 ,, 180	Lafaye	40 ,, 48
Plumean	160 ,, 180	Cagnard	40 ,, 48
Dumas (cru St. Bounet)	120 ,, 160	Négrier	40 ,, 48
Bert	120 ,, 160	Eysson	40 ,, 48
Copmartin	120 ,, 160	Total	40 ,, 48
Guidon	100 ,, 140	Lacroix	40 ,, 48
Normandin	80 ,, 100	Grach, sen.	32 ,, 40
Servant	80 ,, 100	Moreau	32 ,, 40
Servant, sen.	80 ,, 100	Boyer	32 ,, 40
Piganeau	80 ,, 100	Mezuret	36 ,, 40
Dumas	60 ,, 80	Braquessac	32 ,, 36
Daney frères	60 ,, 80	Ponceteau	28 ,, 32
Veuve Normandin	48 ,, 60	Sundry small growers	1100 ,, 1400
Servant, P.	40 ,, 60		

VALEYRAC.

	Hhds.		Hhds.
Chauvelet	480 to 600	Rabère	240 to 280
Haignoux	240 ,, 320	Bert	160 ,, 200
Bédel, sen.	240 ,, 280	Lussac	160 ,, 200
Eqquerir (Dubourdieu)	280 ,, 320	Rousseau	120 ,, 160
Laclaverie	240 ,, 280	Divers	600 ,, 640

IAU.

	Hhds.		Hhds.
Bédel	240 to 280	Bert, sen.	40 to 48
Count de Lussac	160 ,, 200	Bert, jun.	40 ,, 48
R. Bert	280 ,, 320	Figeron	48 ,, 60
Coiffard, jun.	120 ,, 160	Chichet	60 ,, 80
Larcher	60 ,, 80	Dubosq	40 ,, 48
Laumond	40 ,, 60	Dufau	40 ,, 48
Delignac	40 ,, 60		

LESPARRE AND UCH.

	Hhds.		Hhds.
Frechina	240 to 320	Mazeau	60 to 72
Lebeuf	60 ,, 80	Frèche	40 ,, 60
Potié, héritiers Vidal	64 ,, 80	Moneins	80 ,, 100
Marcon	60 ,, 80		

PRIGNAC.

	Hhds.		Hhds.
Dubreuil	160 to 180	Sansot	140 to 160

ST. TRÉLODY.

	Hhds.		Hhds.
J. Guilhem	360 to 400	Mothes	60 to 80
T. Lostau	280 ,, 360	Drouillet	60 ,, 72
Coiffard	240 ,, 280	Gondmeau	48 ,, 60
A. Coiffard	240 ,, 280	Bernard	60 ,, 80
Héritiers Fabre de Rieu-nègre	80 ,, 120	Villa	48 ,, 60
Lhaumond	80 ,, 100	Bernard	60 ,, 72
Célerier	48 ,, 60	D. Drouillet	40 ,, 48
Béneteau	60 ,, 80	Scévola	60 ,, 80
Bonore	60 ,, 80	Piffon	40 ,, 60
		Adde	40 ,, 48

POTENSAC.

	Hhds.		Hhds.
Héritiers Fabre de Rieu-nègre	200 to 240	Moudon	200 to 240
Guilhory	160 ,, 180	Prevasteau	100 ,, 120
Marry de Laloubie . .	200 ,, 240	P. Mouguet	160 ,, 200
Guilhory	160 ,, 180	Guilhem	60 ,, 80
Veuve Gallais	200 ,, 240	F. Hostein	40 ,, 48
Jeanty	360 ,, 400	Mesuret	40 ,, 48
Cousin	200 ,, 240	A. Négrier	32 ,, 48

BLAIGNAN.

	Hhds.		Hhds.
Peychaud	520 to 560	Jabeau	40 to 60
Fabre de Rieunègre . .	240 ,, 280	Faure, J.	40 ,, 60
Guilhory, H	160 ,, 200	Bertin, A.	40 ,, 60
Seguin, J.	120 ,, 160	Bénillan, J.	40 ,, 60
Raymond, P.	100 ,, 120	Ramond	40 ,, 60
Guillet, J.	100 ,, 120	Léraud	40 ,, 60
Thibane, B.	100 ,, 120	Seurin	40 ,, 60
Meynieu, J.	80 ,, 100	Terlé, F.	40 ,, 60
Veuve Potié	80 ,, 100	Augey	40 ,, 60
Terlé, J.	60 ,, 80	De Basterot	40 ,, 60
Delude, P.	60 ,, 80		

ST. YZANS.

	Hhds.		Hhds.
Subercazeaux à Sigognac	600 to 800	André	60 to 80
De Marcellus fils, Château Loudène	400 ,, 600	Veuve Lafaye	48 ,, 60
Tronquoy-Lalande	40 ,, 80	Moreau	48 ,, 60
Mesuret, P	120 ,, 160	Jeanty	40 ,, 48
Jeanty, F.	80 ,, 100	Bournac	40 ,, 48
Lacroix	80 ,, 100	Renou	40 ,, 48
Brion	60 ,, 80	Barbe	40 ,, 48

ORDONNAC.

	Hhds.		Hhds.
Seguin	40 to 48	Héritiers Jouan	48 to 60
Martin	40 ,, 48	Roustaing	48 ,, 60
Marcoulet	40 ,, 48	Veuve Lavaud	48 ,, 60
Arnaud	40 ,, 48	Meynieu	40 ,, 48
Faure	40 ,, 48		

BÉGADAN.

	Hhds.		Hhds.
Cruse (Château Laufac)	800 to 1000	Vital-Eyrem	80 to 100
Cru de Lafite	320 ,, 400	Lapeyre	72 ,, 80
Lussac, A.	320 ,, 400	Brion et Fonteneau	64 ,, 80
Delignac (la Tour du By)	240 ,, 280	Liquard	60 ,, 72
Lambert Mont Blanc	200 ,, 240	Ducasse	60 ,, 72
Lussac	200 ,, 240	Teyssandier	48 ,, 64
Lussac, P.	160 ,, 200	Lussac	40 ,, 48
Lussac de Roulin	160 ,, 200	Cocureau	40 ,, 48
Brion, J.	120 ,, 160	Hostein, J.	40 ,, 48
Barbier	120 ,, 160	Brion, P.	32 ,, 40
Brion, P.	120 ,, 140		

GAILLAN.

	Hhds.		Hhds.
Moutardier, E.	120 to 160	Sudrean	100 to 120
Lacaparère	160 ,, 200	Joffre	40 ,, 60
Fabre de Rieunègre	120 ,, 140	Rey	40 ,, 60
Moutardier, F.	72 ,, 80	Faget	40 ,, 48

CIVRAC.

	Hhds.		Hhds.
Pepin d'Escurac . . .	400 to 440	Gaillar de Bel Air . .	48 to 60
Fréchina	120 ,, 160	Malangin	200 ,, 240
Chauvelet	120 ,, 160	Lussac	60 ,, 80
Marquis de Verthamon, Count de Ségur, Cabanac (Château Berran)	400 ,, 480	Gallouin	120 ,, 160
		Bénillan	80 ,, 100
		Teixier	60 ,, 80
Juillac	72 ,, 100	Meynieu	200 ,, 240
Coutant	80 ,, 120	Veuve Simon	60 ,, 80
Rondeleux	80 ,, 120	Lambert-Carregat . .	120 ,, 160

QUEYRAC.

	Hhds.		Hhds.
Veuve Montauroy (Château Carcanieux) . .	480 to 560	Carle	200 to 240
		Allard	72 ,, 80

ST. VIVIEN.

	Hhds.		Hhds.
De Morin Eycard . . .	40 to 60	Meynieu	40 to 60
Dépé	80 ,, 100	Paché	40 ,, 48
Videau	60 ,, 80	Sundry small growers .	120 ,, 160

THE GRAVES.

The word *Graves* signifies a kind of territory consisting of sand and gravel mixed here and there with more or less clay and marl. This soil occupies the heights in the immediate neighbourhood of Bordeaux. On our viticultural map of the Gironde, we have indicated this district by a greyish blue colour. The same soil occurs also at the confluence of the Garonne and Dordogne. Underneath this territory limestone is met with in most places; in others, however, the so-called *alios*, which we have described as a particular feature of the Médoc. In this district the vine succeeds very well. The wines obtained are of greater body, deeper colour, and more spirituous than those of the Médoc, and, indeed, they resemble much more the wines of the Bourgogne than those of their own immediate neighbourhood, but it may be admitted that they have an altogether particular taste and quality. The bouquet is not great, and they require six or eight years in barrel before they can be put into bottles. After that time, however, they remain excellent. The production of white wines in this district, however, prevails over that of red wines; and we believe the reason of this to be that the red wines of the Graves cannot establish a character for themselves in the world, and are too unlike the Médoc wines to be sold with them, while the white wines which can be there produced are much more similar to the white wines of the district of Sauternes which we shall have to consider hereafter. The white wines have a distinct taste of the pebble, as it is called. Higher up the Garonne, in the whole district of Sauternes, the white wines prevail and no red wines are produced. This district of the white wines we have indicated by a yellow colour, which is, indeed, much nearer the natural colour of the wines produced there than is white, under which term they pass.

The Red Wines of the Graves.—The first quality is that of Château Haut-Brion, distant about six kilomètres from Bordeaux, and situated in the community of Pessac. Its products are classed immediately after those of the Châteaux of Margaux, Lafitte, and Latour. The property has a surface of forty-four hectares. The mode of cultivating the vine here is not the same as in the Médoc, but is that peculiar to the Graves. The principal vines cultivated here are *Grosse Vidure* and the *Vidure Sauvignone*, together with the *Malbec* and the *Cruchinet*. We have, however, seen a good many of the jurançons, and perceived with satisfaction that several of them were in the course of being exterminated and replaced by the sauvignone. The vines stand in rows; the earth is worked by ploughing, in such a direction that the water of the many and heavy rains which fall here flows off easily and rapidly. Each vine is generally trained upon two arms, and after that upon three branches, of which each is supported by a stake. To each arm there is left a cane of six or seven eyes in length and a spur of four eyes. The rest of the operation and the vinification are as in the Médoc. At some distance from Haut-Brion there is an estate called Carbonieux, which belongs to the well-known vinologist, M. Boucherot. This gentleman has a very rich collection of vines of all the world on his estate, amounting to upwards of six hundred varieties. With many of them he has made experiments of plantation and vinification on a large scale. All the American vines have failed in these experiments. The German and other European vines have given indifferent results, and it has been established that the only vines which succeed well in this district are those which are peculiar to it. We have tasted many of the Carbonieux wines, and seen the whole

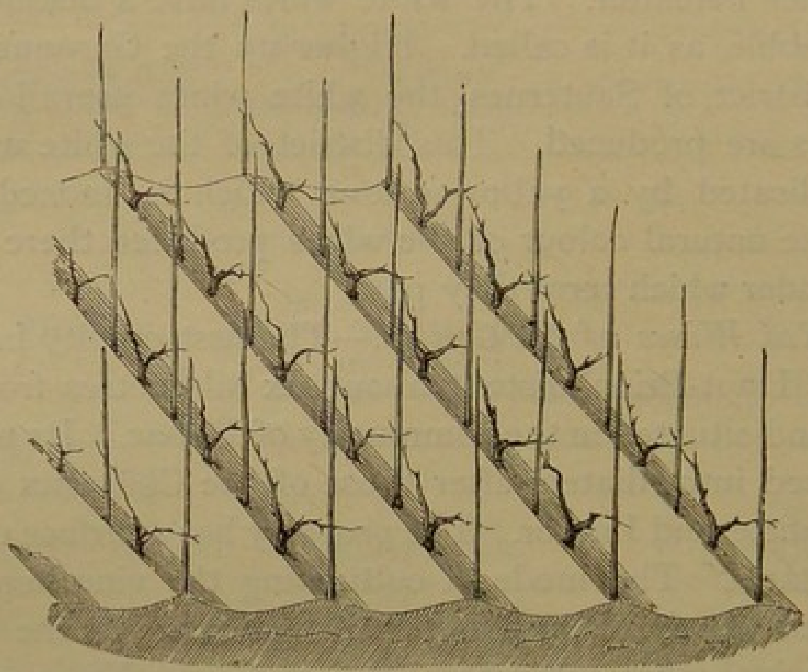


FIG. 57.—Normal cultivation of the Graves.

estate and all its varieties of viticulture, and we have derived much information and pleasure from the urbanity and kindness of M. Boucherot. The other wines grown in this neighbourhood are not wines that can be classed or need to be particularly mentioned.

White Wines of the Graves or Sauternes District.—This district extends on the left bank of the Loire, in the neighbourhood of Langon. Its centre is Bazas, and its eastern termination Captieux. A little west of Podensac, on the Loire, it passes into the Graves of Bordeaux, which we have described before. It is a series of beautiful hills, rising gradually from the Loire towards the south and west, many of them having eastern, others northern, most of them western exposures. They are interspersed with woods and a little cultivated meadow land. The soil is, as before mentioned, gravel and easily worked. The vines planted are almost exclusively of white grapes. They are particularly two in number, namely, the sémillon and the sauvignone, mixed here and there with a little muscatel. It is calculated that the sémillon occupies two-thirds of the surface; the other third is occupied by the sauvignone. The vines stand in lines at distances of a metre in each direction, and are variously dressed. At Barsac all the work on the soil is done by hand;

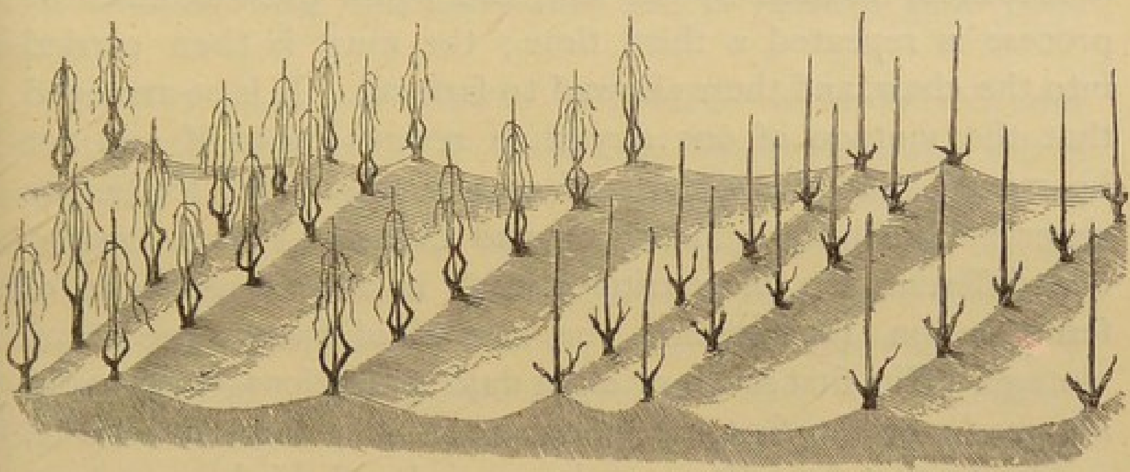


FIG. 58.—Normal cultivation of the Sauternes District.

in Sauternes and Haut-Preignac the plough is used, as in the Médoc, three times a year. Plantations are made by blind canes. In the fourth year of growth the vine is trained upon two arms, and at the end of the fifth year it gets three arms. The pruning is begun in December, and ends about February. The canes are left much shorter than those of Pessac, having three eyes, and the spurs having two eyes. The sauvignone generally gets an eye on each cane or spur more than the sémillon.

Vintage.—The vintage in these districts is altogether different from the vintage in any other part of the world, for the grapes are allowed to hang until they are ripe and rotten, and then they are collected berry by berry, only such berries being taken as fully answer to the description of ripe and rotten. We were present at Château Suduiraut when the vintagers passed through the vineyards for the tenth time, and it was believed that they would have to pass once or twice more. This was near the end of October. Generally speaking, however, the grapes are collected in about three successive harvests. As there is a great deal of time employed in this harvesting, and no rapidity of work required, the population of the district and the ordinary labour suffices; and there is no gathering of labourers as in the Médoc and the Champagne at the time of the vintage. The grapes are crushed and pressed, and the sweet thick must which flows off is put into barriques. When the first must has run off, the murk is loosened, trodden by the feet, and again pressed, and this process is repeated a third time; the must is then carried into the chais, and there allowed to ferment. It is so arranged that the vintage of one day shall remain by itself, and not be mixed with the vintage of another day. In October we observed at Château Suduiraut and Château Yquem twenty-one different sets of barriques, each in a different stage of fermentation, representing the results of twenty-one days' vintage. The first seven or eight days' collections, when many are made, or the first collection, when only three are made, are kept apart from those of the second and third seven days, or the second and third collections. The first seven days give generally what is called the "head" wines—*vins de tête;* these are the sweetest and heaviest. The second collection generally gives *vins de milieu,* or wines of the middle, which are less heavy and contain less sugar, and a third class are wines of the tail, or *queues,* which are the result of the pressing of all the grapes that remain after the other selections have been made. These latter yield the driest wines: therefore in tasting the white wines of this district one has to taste first the three qualities of head, middle, and tail, and then a mixture of equal parts of the three. By means of this particular treatment of the grape a must is obtained which is exquisitely sweet: this sweetness remains to a great extent throughout the whole life of the wine. Indeed, the Sauternes wines and all white wines of the Gironde, which are similarly made, are now of such a nature that they are spoiled for the

English, and let us add every other good, taste. The excessive sweetness is given to them mainly on account of the great demand which exists for sweet Sauternes wines in Russia. During our visit to this district we tasted an enormous number of wines, and we are certain that, with the exception of a few queues, not a barrel even of the finest wines of Yquem would fetch the demanded price in England. We deplore this as a great loss to the oinophilist, for the dry fine wines of Sauternes were once amongst the great favourites of the wine-lovers' cellars, and they have now almost entirely disappeared. Indeed, Sauternes are now, or will be soon, what Muscat-Lunel and Rivesaltes have been hitherto.

The fermentation is allowed to proceed in the barrels, and the yeast is not allowed to be cleared out at the bung, but is compelled to sink in the fluid. This is very necessary, as otherwise the quantity of unfermented sugar in the liquid would become excessive. During four or five years the head wines have a disagreeable flavour, but a powerful alcoholicity and much body. The flavour improves as they become drier. The more liquorous the wine is the longer it must be kept before its strong and peculiar flavour is adjusted to the right medium.

The principal growths of the district are the Barsacs, Sauternes, and Bommes. From the heights of Sauternes and from the castle of Yquem a most splendid view of the Valley of the Loire is obtained. It is one of the finest landscapes in Europe.

WHITE WINES.

FIRST GROWTHS.

				Hhds.
Château Yquem .	Sauternes .	—	B. de Lur-Saluces .	560 to 720
La Tour Blanche .	Bommes . .	—	Veuve Focke . . .	180 ,, 220
Peyraguey . . .	Do. . .	—	Veuve P. Lafaurie .	240 ,, 320
Vigneau	Do. . .	—	De Pontac . . .	200 ,, 240
Suduiraut . . .	Preignac . .	—	Guilhot, frères . .	400 ,, 480
Coutet	Barsac . .	—	B. de Lur-Saluces .	400 ,, 480
Climenez . . .	Do. . .	—	Lacoste	200 ,, 240
Bayle	Sauternes .	—	F. Solar	240 ,, 320
Rieusec	Do. . .	—	Mayé	80 ,, 120
Rabaut	Bommes . .	—	Deyme	60 ,, 100

SECOND GROWTHS.

				Hhds
Myrat	Barsac . .	—	H. Moller . . .	120 to 140
Doisy	Do. . .	—	Daenne	40 ,, 48
Peixotto	Bommes . .	—	Veuve Lacoste . .	80 ,, 100
D'Arche	Sauternes .	—	Lafaurie & Co. . .	132 ,, 200
Filhot et Hineaud .	Do. . .	—	B. de Lur-Saluces .	400 ,, 480
Broustel et Neyrac	Barsac . .	—	Capdeville . . .	120 ,, 160
Caillou	Do. . .	—	Sarraute	80 ,, 100
Suau	Do. . .	—	Marion	60 ,, 72
Malle	Preignac . .	—	H. de Lur-Saluces .	320 ,, 400
Romer	Do. . .	—	De la Mayre-Mory .	120 ,, 160
Lamothe	Sauternes .	—	Veuve Baptisté . .	92 ,, 120
Do.	Do. . .	—	Massieux	92 ,, 120

Description of the Wines.—The wines of Barsac have much body, are very alcoholic, and have a fine bouquet. They are more heady than the Sauternes, and have a more lively taste and a more amber-tinted colour. The first growth of the district of Barsac is the Château Contet. The wines of Sauternes are more marrowy and fine, more transparent and agreeable. The Château Yquem produces the finest of all the Sauternes wines, and is one of the jewels of France. Its annual yield is four hundred hogsheads. In great exceptional years the Château Yquem wines become quite liquorous, and are then like those concentrated straw wines which were once so frequently made in the south of France. In ordinary good years it preserves its superiority over all the other Sauternes wines, but is always very spirituous. In 1844 the Château Yquem wine was worth 12,000 frs. the tonneau. We tasted at the Château wine four or five years old, for which 12,000, and other qualities for which 15,000 francs were demanded. This wine, through its reputation, has, in fact, become too dear for use. The 1865 we found beautiful; the tête was excessively sweet, almost like syrup, and when it was mixed with the tail it sank in it like syrup of high specific gravity. The 1866 was not very good; it was too hot and alcoholic. The 1867 which had just been pressed amounted only to forty tonneaux instead of the usual hundred and fifty. The 1864 we found very fine, but too dear at 12,000 francs. The 1861 we pronounced splendid, but not yet ripe for bottling. We calculated that after bottling it would cost about fifteen francs the bottle. At Château la Tour Blanche we tasted the 1865, which was very fine indeed: its flavour was very similar to fine Rhine wine; it was not so sweet as the Yquem. The 1867 vintage also yielded only half the usual quantity. The têtes of the 1865 were also too sweet; the middles and tails were better. To our taste the 'sixty-fives' of Château la Tour Blanche were far superior to the same year's Château Yquem. The 1864 La Tour we found an excellent wine, not too sweet, and the ensemble was very fine, with a full nice flavour, and ready for bottling. At Château Suduiraut we tasted 1859 at 4,000 francs the tonneau, and this we pronounced a perfect wine and very valuable; it is, in our opinion, the white parallel of the red Saint Emilion. The 1864 was very sweet and made expressly for Russia. The 1864 tail we found very good, and, considering that it was a tail, extraordinary sweet. The 1864 tête we found very delicate, and attributed to it great finesse. The 1857 we found a beautiful dry wine, four years in bottle after being six years in barrel. We drank a bottle of it in the chais. The happy proprietor informed us that he drank a bottle of this wine daily for his breakfast. In this enormous establishment, which was shown to us by the proprietors with the greatest urbanity and politeness, we saw nine large presses, each at least two metres square, all in full operation. The chais was full of barriques of wine, all of the last eight or nine years; and what ordinarily may be called a pleasure—namely, the tasting of these wines—became, through the necessity of tasting each quality four times, a heavy and intoxicating labour. This estate is distinguished by a splendid natural advantage, namely, rich sources of flowing spring water, from which we regaled ourselves after our wine tasting was over. While 80 or 100 tonneaux are produced yearly in ordinary years, the year 1867 yielded only half a vintage.[1]

[1] At Château Suduiraut we observed an amusing little incident, illustrative of the views which one may take of the hypocrisy of "tasting." In tasting, the wine is supposed to be spat out after being rolled about the mouth for a few moments; and the tasters maintain that they are not in the habit of swallowing any, and that

At Château Desmirail we tasted 1864. The middle was good; the head sweet. The 1865 tail was very good indeed. The 1865 head was too sweet for England, good for Russia. Its value was about 2,000 frs. per tonneau. At Rieussec, on a large wine farm which produces some of the first growth, we found that only ten tonneaux were produced this year, being about a quarter of the ordinary production. The vines had suffered much during flowering, afterwards from hail, and a little from the oïdium. All the fresh musts were very sweet and fermenting slowly. Of the 1865 there were twenty-seven tonneaux, of which the head was very sweet and the tail slightly bitter. The 1866 we did not find to be very good.

Preignac yields a wine which is less heady than that of Sauternes and Barsac. The wine of Carbonieux, which we have already mentioned, although similar to Sauternes, is never so liquorous, and in years when the Sauternes is only half liquorous becomes dry. We consider the dry wines, or at all events the moderately sweet and spirited wines, to be much more wholesome than the sweet heavy wines, and it is for this reason that we deplore the change in the production of wine in the Sauternes district, which is now almost accomplished.

they are not obliged to swallow any for the purpose of getting a perfect taste. While we were tasting the 1857 wine, the proprietor's little son came near, and his father asked him whether he would drink. "Yes," he replied, and then putting the glass to his mouth he drank the contents; but as the company was not supposed to drink, but only to taste, the father jocularly admonished the son to spit a little—"*Crachez un peu.*" We all laughed at this little satire on professional tasting, for we believe and know from the effects of the tasting, that, although the tasters profess not to swallow any wine, they all swallow more than they spit out.

VITICULTURAL STATISTICS OF THE SAUTERNES DISTRICT PRODUCING WHITE WINES.

(*Showing under the heading of each community the names of the proprietors of vineyards, and the average number of hogsheads of wine produced annually in each.*)

LANGON.

	Hhds.		Hhds.
Colas à Ludeman . . .	60 to 80	Brannens, à Toumetton .	120 to 160
Goua	60 ,, 80	Léglise	60 ,, 80
Merle	80 ,, 120	De Mirambet	40 ,, 48
Duprat, au Maine . .	100 ,, 120	Grenier	48 ,, 60
Fourcassie	60 ,, 80	Cazenave-Champré . .	40 ,, 48
Cluzan	48 ,, 60	Dupont	40 ,, 48
De Château	80 ,, 100	Capdeville	60 ,, 80
Caubet	48 ,, 60	Villefranche	48 ,, 60
Castaing	40 ,, 48	De Baritault	60 ,, 80
Lamalétie	48 ,, 60	Ardusset	48 ,, 60
Biros	48 ,, 60	Larrieu	48 ,, 60
Nibaut	40 ,, 48	Branneins fils frères, Magens et Boriac . . .	120 ,, 160
Ducasse	40 ,, 48	Colac	100 ,, 120
Lafarque	40 ,, 48		
Gervais	40 ,, 48		

ST. PEY, OR ST. PIERRE DE MONS.

	Hhds.		Hhds.
De Poutac	140 to 160	Pauly	120 to 140
Baritault du Capriac . .	100 ,, 120	Aubergier	100 ,, 120
De Castelnau	120 ,, 160	Colas	80 ,, 100
Crannens	100 ,, 120	Monclin Patachon . .	48 ,, 60
Mamie	72 ,, 96	Lafon	40 ,, 60
Bouhreau	80 ,, 100	Duzan	48 ,, 60
Dubourg	80 ,, 96	Pauly, jeune	40 ,, 48
St. Blancard-Bernardine .	72 ,, 80	Verdale	40 ,, 48
Colas	60 ,, 80	Palachon	48 ,, 60
De Reyne	100 ,, 120	Trompette	48 ,, 60
Lamarque	28 ,, 40	Pauly, jeune	28 ,, 40
Carpentey	48 ,, 60	Cazenave-Bourbon . .	28 ,, 40
Colas St.-Marc . . .	48 ,, 60	St. Blancar Seguis . .	28 ,, 40
Brannens	120 ,, 140	Gramidon	28 ,, 40
Marashe	200 ,, 240	De Lur-Saluces . . .	28 ,, 40

TOULENNE.

	Hhds.		Hhds.
Catelan	200 to 240	Lafargue	40 to 48
Ladonne	100 ,, 120	Grignon	40 ,, 48
Dubourdieu	60 ,, 80	Sarrazin	24 ,, 40
Cazenave	60 ,, 80	Pardiac	20 ,, 40
Fauret	48 ,, 60	Theri	20 ,, 40

FARQUES DE LANGON.

	Hhds.		Hhds.
Becquet	80 to 100	Despujols-Mothes . . .	40 to 48
Amé-Lafargue	80 ,, 100	Despujols-Mothes, jun. .	40 ,, 48
Brustis-Filhau	40 ,, 48	Les Claverie	40 ,, 48
St. Blancar	40 ,, 48	La Barbe Moulette . .	16 ,, 24
Veuve St. Blancar . .	40 ,, 48	Dastouet-Bureau . . .	40 ,, 48
St. Espès-Boyrin . . .	40 ,, 48	Batsalle	40 ,, 48

PREIGNAC.

	Hhds.		Hhds.
Héritiers Guilhot, à Suduiraut	400 to 480	Veuve Pinsan, au Haire .	40 to 48
Comte de la Myre-Mary, à Montalier	120 ,, 160	J. Pinsan, do. .	32 ,, 40
Comte H. de Lur Saluces, à Malles . . .	320 ,, 400	Boireau, do. .	32 ,, 40
Danez frères, au Sahue .	200 ,, 240	Commets, do. .	48 ,, 60
Apian, aux Ormes . .	160 ,, 200	P. La Trisote do. .	32 ,, 40
Vcte. Delbos, à Vegres .	160 ,, 200	Clavier, do. .	32 ,, 40
Larrieu, à la Montagne .	400 ,, 480	Sauzin-Guilmanseau, do.	40 ,, 48
Godard, à St. Aman . .	40 ,, 60	Divers, du Haire . . .	100 ,, 120
Betbeder frères, à Picq .	180 ,, 220	Rondée-Labarinthe . .	60 ,, 80
Larrieu, au Pleytégeat .	120 ,, 160	Guichard, à Lamothe .	48 ,, 60
Lahens, à Solon . . .	48 ,, 60	Duron, do. .	40 ,, 48
Soubiran, aux Arrieux .	100 ,, 120	Despujols, do. .	48 ,, 60
Dutauzin, au Mayne . .	240 ,, 280	Pinsan-Cato do. .	32 ,, 40
Alary, à Laville . . .	80 ,, 100	Desplandre do. .	32 ,, 40
Ladonne	80 ,, 100	Divers, do. .	100 ,, 120
Veuve Dardu	60 ,, 80	Patachon, à Mededon .	60 ,, 80
Lagardère	60 ,, 80	Huillette do. .	48 ,, 60
Bertin, à Boutoc . . .	48 ,, 60	Soré do. .	32 ,, 40
Lafon, do. . . .	60 ,, 80	Dufau do. .	32 ,, 40
Fabre, do. . . .	60 ,, 72	Léglise do. .	40 ,, 48
Lassauvajue-Mogey . .	48 ,, 60	Desqueyroux, do. .	24 ,, 32
Lassauvajue, jun. . . .	32 ,, 40	Dubrey frères, do. .	48 ,, 60
Bertin, jun.	32 ,, 40	Diverses, à Mededon . .	40 ,, 48
Bertin d'Armiche . . .	40 ,, 48	Pinsan frères	48 ,, 60
Lados	40 ,, 48	Dufau	32 ,, 40
Bertin frères	40 ,, 48	Divers, au Puck . . .	60 ,, 80
Boyreau-Boyrelot . . .	40 ,, 48	Dubourg	64 ,, 80
Lafon, sen.	32 ,, 40	De Rolland, au bourg .	60 ,, 80
P. Bertin	32 ,, 40	Despujols, jun., do. .	48 ,, 60
Bertin, à Boutoc . . .	40 ,, 48	Vcte. de Valens, do. .	40 ,, 48
Capdeville, do. . . .	24 ,, 32	Dubos, do. .	32 ,, 40
Divers, do. . . .	80 ,, 100	Lamothe, do. .	32 ,, 40
Pinsan Bréton, au Haire	60 ,, 72	Despiet, do. .	40 ,, 48
Pinsan Gressus, do. .	48 ,, 60	Lahileau Paillotte, do. .	32 ,, 40
		Beguey, do. .	32 ,, 40
		Lacoste frères do. .	60 ,, 80
		Divers, do. .	80 ,, 100

SAUTERNES.

	Hhds.		Hhds.
Marquis de Lur-Saluces, Château Yquem . .	560 to 720	Dubedat	32 to 40
		Comet	32 ,, 40
Marquis de Lur-Saluces, domaines de Filhot et Hineaud	400 ,, 480	Faugas frères	48 ,, 60
		Meric, Château d'Arche .	40 ,, 48
		Lafon frères	32 ,, 48
Solar, domaine du Bayle	240 ,, 320	Veuve Lafon	32 ,, 40
Laporte, domaine de Lamothe	32 ,, 40	Dupeyron cru d'Arche .	32 ,, 40
		Ducos	32 ,, 40
Massieux, do.	60 ,, 80	Espagnet	32 ,, 40
Vaudier, domaine de Commarque	40 ,, 60	Lafon	32 ,, 40
		Dubourg	24 ,, 32
Lafaurie-Camille, cru d' Arche	60 ,, 100	Lafon, A.	24 ,, 32

BOMMES.

	Hhds.		Hhds.
Veuve Lafaurie, au Château Péraguey . . .	240 to 320	De Pontac, M. . . .	100 to 120
		De Castelmore . . .	48 ,, 80
Deyme, au Rabaut . .	60 ,, 100	Latestère, au Haut-Bommes	48 ,, 60
De Pontac, G., cru du Vigneau	200 ,, 240	Daulan (la Jeunesse), do.	48 ,, 60
Veuve Focke, à la Tour Blanche	160 ,, 220	R. St. Pierre	48 ,, 60
Veuve Lacoste, à Peixotto	80 ,, 100	Lassauvajue - Mogey, à Preignac	48 ,, 60
De Pontac, G. . . .	160 ,, 200		

BARSAC.

	Hhds.		Hhds.
Marquis de Lur-Saluces .	400 to 480	Boireau-Charrette . .	60 to 80
Lacoste	200 ,, 240	Lacoste et Rey . . .	60 ,, 80
Veuve Duboscq . . .	200 ,, 240	Marion	60 ,, 80
Debans	120 ,, 160	Boireau	48 ,, 60
Cte. de Lur-Saluces . .	120 ,, 160	Guilhem-Clouet . . .	48 ,, 60
Capdeville	120 ,, 160	Amanieu frères . . .	40 ,, 60
Moller	120 ,, 140	Latourneri-Lamé . . .	48 ,, 60
Malignon	120 ,, 140	Daenne	40 ,, 60
Danglade frères . . .	100 ,, 120	Faux	40 ,, 48
Laborde	100 ,, 120	Despujols	40 ,, 48
Lacoste-Pinsan . . .	80 ,, 120	Ducaule-Laguerre . .	40 ,, 48
Sarraute	80 ,, 100	Sargos	40 ,, 48
Journu	60 ,, 100	Hugounet	40 ,, 48
Veuve Ledentu . . .	60 ,, 80	Marillot	40 ,, 48
Lacoste	72 ,, 80	Espagne	40 ,, 48
Cazalis	60 ,, 80	Libéral	40 ,, 48
Baulac frères	60 ,, 80	Coutanceau	40 ,, 48
Cottineau	60 ,, 80	Ducasse	40 ,, 48
Castéra-Dudon . . .	60 ,, 80		

PUJOLS.

	Hhds.		Hhds.
Clos St. Robert . . .	100 to 120	Guiaste, J.	32 to 40
Fonsèque	60 ,, 80	Lacoste-Labartouille . .	32 ,, 40
Cadillon	60 ,, 80	Veuve Bonnet	32 ,, 40
Dupart de Cadillac . .	48 ,, 60	Audine	32 ,, 40
Guiaste	48 ,, 60	Taudin	32 ,, 40
Labarthe	48 ,, 60	Lacoste-Pesiquan . . .	32 ,, 40
Veuve Tauzin-Bley . .	48 ,, 60	Giral frères	32 ,, 40
Dupant	32 ,, 40	Cheveaux frères . . .	24 ,, 32
Bonnet	32 ,, 40	Escudey-Sagnerie . . .	24 ,, 32
Claverie	32 ,, 40	Tauzin-Thierre . . .	24 ,, 32

ILLATS.

	Hhds.		Hhds.
Ballion, G.	200 to 320	Ricaud	60 to 80
Dubourg-Larrondey . .	60 ,, 100	Vincent (Vinautot) . .	40 ,, 60
Avezon	40 ,, 60	Ducau (Drôle)	60 ,, 80
Dubourg-Pontet . . .	40 ,, 60	Vincent (Menaton) . .	40 ,, 60
Ducau-Jeanty	60 ,, 80	Lapujade	60 ,, 80
Dubry-Dubrille . . .	100 ,, 140	Cantau-Caduhan . . .	40 ,, 60
Taffard	240 ,, 320	Dubas-Mongneau . . .	60 ,, 80
Dorgueuilh	40 ,, 60	Tauzin-Pistaulan . . .	60 ,, 80
Lalande-Lapave . . .	60 ,, 100	Dubrey frères	40 ,, 60
Cazeaux-Lagnet . . .	40 ,, 60	Dubrey-Expertille . .	40 ,, 60
Dubourg-Larrat . . .	40 ,, 60	Cazeaux	40 ,, 60
Dubourg-Larrat, jun. .	40 ,, 60	Lafosse	40 ,, 60
Boireau	40 ,, 60	Cendrey	40 ,, 60
Lalande-Jouriac . . .	40 ,, 60	Paguenaud	40 ,, 60
Ducau	160 ,, 180	Billaud	40 ,, 60
Daney	60 ,, 100	Ducau-Baston	40 ,, 60
Paquenaud (Fort) . . .	40 ,, 60	Dulon	40 ,, 60
Destrac (Cardillac) . .	40 ,, 60	Dubourg-Lionne . . .	60 ,, 80
Cantau	40 ,, 60	Dubourg-Ricaud . . .	60 ,, 40
Vincent	40 ,, 60		

LANDIRAS.

	Hhds.		Hhds.
De Chalup au Portoil .	100 to 160	Dubeau	60 to 80
Taffard	80 ,, 120	Ricaud	40 ,, 60
Canteau	60 ,, 80	Robit	40 ,, 60
Bonifas	60 ,, 80	Dutrenit	64 ,, 68
Dupey	120 ,, 160	La Vincente	60 ,, 80
Bacquey	48 ,, 60	Ricard	40 ,, 60
Jouis	60 ,, 80	Champagne, sen. . . .	28 ,, 40
J. Dutrenit	40 ,, 60	Champagne, jun. . . .	28 ,, 40
Dutrenit	40 ,, 60	Lasserre	40 ,, 60
De Tauzin	40 ,, 60	Canteau	36 ,, 48

CERONS.

	Hhds.		Hhds.
Cte. de Calvimont . .	140 to 200	Expert	60 to 80
Libéral	80 ,, 120	R. Medeville	80 ,, 100
P. Biarnez	160 ,, 240	C. Medeville	120 ,, 160
Lataste frères	60 ,, 72	Cobillon-Medeville . .	160 ,, 200
Lataste	80 ,, 100	Ducau-Baston	160 ,, 200
Lataste, dit Citoyen . .	60 ,, 80	Expert-Paysan	100 ,, 120
Lataste, sen.	48 ,, 60	Expert, dit Grenadier .	60 ,, 80
Lataste	48 ,, 60	Nercam-Bernachon . .	40 ,, 64
A. Ducau	60 ,, 80	Nercam-Andrille . . .	60 ,, 80
J. Ducaule	40 ,, 60	Expert-France	40 ,, 60
Nicaule-Ducau . . .	60 ,, 80	Expert-Farcy	40 ,, 60
Ducau-Lapeley . . .	80 ,, 120	Expert la Grêle . . .	40 ,, 60
Ducau-Thain	40 ,, 60	Expert-Quatre	24 ,, 40
Lescourères-Montille . .	80 ,, 120	Expert-Pasquet . . .	24 ,, 40
Lataste-Dauphin . . .	60 ,, 80	Treilhe frères	60 ,, 120
Lataste-Expert . . .	40 ,, 60	Chevalier-Loulom . .	40 ,, 48
Laforge-Expert . . .	40 ,, 60	Mederie-Pourquey . .	40 ,, 48
Expert-Nans	60 ,, 80	A. Pourquey	32 ,, 40
Expert-Ratié	40 ,, 60	B. Pourquey	28 ,, 40
Expert-Lamouroux . .	40 ,, 60	Ducau-Nicaule . . .	28 ,, 40
Gillard	40 ,, 60	Bergez-Avril	40 ,, 60
De Chalup	40 ,, 60	V. Vincentot	40 ,, 60
Gillard, E.	60 ,, 100	Launeluc	40 ,, 48

PODENSAC.

	Hhds.		Hhds.
Gassies, A.	180 to 200	Jasseau, J.	72 to 80
Biarnès, C.	160 ,, 180	Lataste	60 ,, 80
Biarnès, P.	120 ,, 140	Péringuey	60 ,, 72
Vergez	120 ,, 140	Expert, héritiers . . .	60 ,, 72
Pichausel	120 ,, 140	Rousseau	48 ,, 60
Dorgueuilh-Bérot . . .	60 ,, 80	Bordessoulle	48 ,, 60
Richet	120 ,, 140	Jasseau, P.	48 ,, 60

VIRELADE.

	Hhds.		Hhds
Douder	160 to 200	Bedouret	32 to 40
De Carayon-Latour . .	80 ,, 100	Mothes	32 ,, 40
Bordessoulles	60 ,, 80	Labat	32 ,, 40
Desclaux	40 ,, 60	Bahans	24 ,, 32
Tapie	40 ,, 60	Pemerle	24 ,, 32
Lasserre-Gaston . . .	40 ,, 60	Blaneau frères	24 ,, 32
V. Cassinet	40 ,, 60	Bernada	24 ,, 32
Autin-Gilles	32 ,, 40	Lasserre frères	24 ,, 32

ARBANATS.

	Hhds.		Hhds
Baron de Carayon-Latour	200 to 240	Descacq	40 to 48
Lucbert	40 ,, 60	Laulan	20 ,, 24
Lachâtre	120 ,, 160	P. Bisquay	24 ,, 32
Dubroca	40 ,, 48	Labat (cru de Bel-Air) .	60 ,, 80

Besides the above white wines, this commune also grows the following red wines:—

	Graves.	Palus.
	Hhds.	Hhds.
Baron de Carayon-Latour	200 to 240	600 to 800
Lucbert	—	240 ,, 280
Lachâtre	60 ,, 80	—
Dubroca	32 ,, 40	32 ,, 40
Descacq	32 ,, 40	32 ,, 40
Laulan	32 ,, 40	—
Gaubert (cru Tourteaux)	100 ,, 120	300 ,, 320
Labat (cru de Bel-Air)	60 ,, 80	—

VITICULTURAL STATISTICS OF THE PART OF THE GRAVES OR SAUTERNES DISTRICT PRODUCING RED WINES.

(*Showing under the heading of each community the names of the proprietors, and the average number of hogsheads of wine annually produced.*)

MERIGNAC.

	Hhds.		Hhds.
Dumon, à Château Bonair	320 to 400	Lanefranque	72 to 80
Bonnet, Château de Bouran	140 ,, 160	Caillavet	60 ,, 80
Pigautier	120 ,, 160	Silveyra	60 ,, 72
La Tour de Veyrine . .	120 ,, 160	Gintrac	60 ,, 72
L'Archevêché	100 ,, 120	Lacoste	48 ,, 60
Doussous, à Luchey . .	120 ,, 160	Mercier	48 ,, 60
Wyndham	80 ,, 100	Baour	48 ,, 60
Petiteau	72 ,, 80	Merignac	48 ,, 60
Ducasse	72 ,, 80	B. Laffarque	40 ,, 48
M. Isaacson	72 ,, 80		

GRADIGNAN.

	Hhds.		Hhds.
Roux	120 to 160	Berges	40 to 60
Rodrigues	120 ,, 160	Dupuch	60 ,, 80
Bergmiller	80 ,, 120	Alphonse	40 ,, 60
Mauzé	100 ,, 140	Pichard	40 ,, 48
Dalidet	80 ,, 120	Dupeyrat	40 ,, 48
Moulinié	80 ,, 120	De Kercado	20 ,, 40
Rodrigues, C.	80 ,, 120	Paysans	32 ,, 40

PESSAC.

	Hhds.		Hhds.
Château Haut Brion . .	360 to 400	Meller (Verthamon) . .	48 to 60
Château-Neuf de Haut Brion	100 ,, 120	Garcia	40 ,, 48
Château Ste. Marie et Pape Clément . . .	100 ,, 120	Grangeneuve	24 ,, 32
La Mission	100 ,, 120	Fournier	32 ,, 48
Lachapelle	100 ,, 120	Deney	32 ,, 40
F. Bahans	60 ,, 80	Ledoux	20 ,, 40
Baron Sarget	60 ,, 80	Jaubert	20 ,, 40
Les Carmes	60 ,, 80	Bersat	16 ,, 24
Gaussens	48 ,, 60	Thomas	16 ,, 24
		Veuve Montagny . . .	16 ,, 24
		F. Coutine	12 ,, 20

TALENCE.

	Hhds.		Hhds.
Chiapella	140 to 160	Megret	40 to 48
Larrieu	60 ,, 80	Cujol	40 ,, 48
Cayrou	80 ,, 100	Gommez-Vaëz	40 ,, 48
R. de Sauvignon . . .	48 ,, 60	H. Luc	40 ,, 48
Roul	48 ,, 60	Tarel.	40 ,, 48
Bernos	48 ,, 60	Cuginaud	40 ,, 48
J. Durand	40 ,, 48	Labalette	40 ,, 48
Gautier	40 ,, 48	A. Hérin	40 ,, 48
Laclaverie	60 ,, 48	Dérussac	40 ,, 48
Bouscasse	40 ,, 48	De Lamballerin . . .	40 ,, 48
Pommez.	40 ,, 48	Devèze	40 ,, 48
Veuve Grand	40 ,, 60	Daney	32 ,, 40
Raba	40 ,, 48	Hallagray	20 ,, 24
Tarteyron	60 ,, 80	Festugière	24 ,, 32
Thevenard	40 ,, 48		

LÉOGNAN.

		Hhds.			Hhds.
Château Louvières . . .	B. Mareilhac .	120 to 160	L'Hermiton .	Louvet . . .	80 to 100
Larrivet . . .	De Taffard et De Sulzer.	280 ,, 320	Petit-Bourdieu	Pujos . . .	100 ,, 120
Château Branon de Licterie .	A Calvé . .	120 ,, 160	Ci-devt. Brown	Roux . . .	80 ,, 120
Château d'Olivier.	Count d'Etchegoyen . .	160 ,, 200	Bailly . . .	Ricard . . .	80 ,, 120
Laqueloup . . / Mouton . . .	Depiet. . .	160 ,, 200	Barreyre . .	Moreau-Berton	80 ,, 100
			Lessence . .	Bénecké. . .	60 ,, 80
			Freuzal et Seguin . . .	De Griffon . .	48 ,, 60
			Château-Neuf .	Th. Ducos . .	120 ,, 160
			Pontaulie . .	Bascle . . .	40 ,, 48

VILLENAVE D'ORNON.

GRAVES.

		Hhds.			Hhds.
Pontacq-Moustier . . .	Souton . . .	300 to 340	Madère . . .	Buchon . . .	60 to 80
Carbonieux. .	Boucherot . .	160 ,, 100	Do. . . .	Sancet . . .	20 ,, 40
Brignon. . .	Fabre . . .	140 ,, 160	Do. . . .	Jude. . . .	32 ,, 40
Lahontan . .	A. de Basquiat	80 ,, 120	Pont de la Maye	Lange . . .	60 ,, 80
Cohins . . .	R. de Basquiat	80 ,, 120	Do. . . .	Latransa . .	40 ,, 60
Le Désert . .	De Sandol . .	60 ,, 80	Au bourg . .	Couperie . .	24 ,, 32
Pont de Langon	Duprat . . .	120 ,, 160	Do. . . .	Dupouy. . .	48 ,, 60
Baret . . .	Redling. . .	60 ,, 80	Château Sallegourde.	Héritiers de Pradines. .	40 ,, 48
Madère . . .	Dupuy . . .	100 ,, 120	Au bourg . .	Lartigue . .	24 ,, 40
Do. . . .	Guichon . .	60 ,, 80	La Mounaie .	Laffargue . .	40 ,, 60
Do. . . .	Lecler . . .	60 ,, 80	Galgon . . .	De Labarre .	40 ,, 60

PALUS.

		Hhds.			Hhds.
Geneste . . .	Allendy. . .	560 to 640	— —	Depiot . . .	100 to 172
Courréjan . .	Marquis d'Alon	240 ,, 280	Lessence . .	N.	60 ,, 80

PETITS VINS ROUGES DE GRAVES.

MARTILLAC.

FIRST SECTION.

		Hhds.			Hhds.
Smith . . .	Duffour-Dubergier.	320 to 400	Breyra . . .	Conil . . .	100 to 120
			Do. . . .	Castaing . .	60 ,, 80
Lartique . .	Gaschet. . .	240 ,, 280	N.	Levallois . .	60 ,, 72

SECOND SECTION.

		Hhds.			Hhds.
Roche-Morin .	De Montesquieu.	320 to 400	Lantié . . .	De Venancour.	120 to 160
			Couvent. . .	Noailles . .	100 ,, 120
N.	Bazanac . .	160 ,, 200	Lespean. . .	Bentéjac . .	100 ,, 120

ST. MEDARD D'EYRAN.

	Hhds.		Hhds.
Brochette de Larochetière .	200 to 240	De Carayon	80 to 100
De Raymond	100 ,, 120	Delpech.	100 ,, 120
Lort	100 ,, 120	Mannan	80 ,, 100
Cante	100 ,, 120	Depiot	72 ,, 88
Manes	100 ,, 120	Vigouroux	60 ,, 80
De Sèze	80 ,, 100	De Baritaut.	60 ,, 80

LA BREDE.

	Hhds.		Hhds.
Dergottes	200 to 240	Rougeol.	100 to 120
Abiet	200 ,, 240	Reynal	80 ,, 100
Lacombe	160 ,, 200		

ST. MORILLON.

	Hhds.		Hhds.
De Baritault	280 to 320	Lillet	120 to 160
Desbarat	240 ,, 280	Boyreau	120 ,, 160
Bleynie	320 ,, 360	Guilhemin	120 ,, 160
Veuve Roullet. . . .	200 ,, 240	De Bosredon	120 ,, 160

WINES OF THE HILL-SIDES, OR CÔTES OF THE GIRONDE.

Vineyard of St. Emilion.

Those wines of the Gironde, which are called wines of the hill-sides, or "*Vins de Côtes*," are obtained on a chain of hills which extend along the right bank of the Garonne from Ambarez to Sainte-Croix-du-Mont. The northern part of this district produces in general wines of a dark colour, sometimes hard and rough at first, but ameliorating with age. They are exported under the name of "wines of the good hill-sides." In the southern part, only little red wine is made, but much white wine of a dry quality, called "wine of the little hill-sides." Under this latter denomination, the Bordeaux trade includes also the wines of the right bank of the Dordogne, from Bourg, which is about twenty kilometres north of Bordeaux, to Fronsac, which is about twenty-four kilometres north-east of Bordeaux. Among all these wines, the most celebrated are those which are grown in the community of Saint Emilion and generally named after that district. The surrounding districts give also wines, but less fine than those of Saint Emilion. Pomerol may rival these latter ones, but its wines have to be sold under its own name. The vineyards of Saint Emilion occupy 1,041 hectares. The best qualities are obtained on the plateau of the Madeleine and Saint Martin, and on the inclines towards the south and west of the Saint Emilion hills. There are yet first-class wines north of the town of Saint Emilion. This town was a stronghold of the Knights Templars; and of their churches and order-houses innumerable ruins exist, interspersed with inhabited houses. The soil on the hill-sides is a chalky clay, lying upon rock. Lower down the territory becomes sandy, and rests frequently upon a ferruginous underground. The varieties of grapes met with in this district are the *Noir de Pressac*, the *Merlot*, and the *Bouchet*, or *Cabernet*. We know the Merlot to be one of the vines of the Palus or marshes, and the Cabernet to be one of the best of the vines

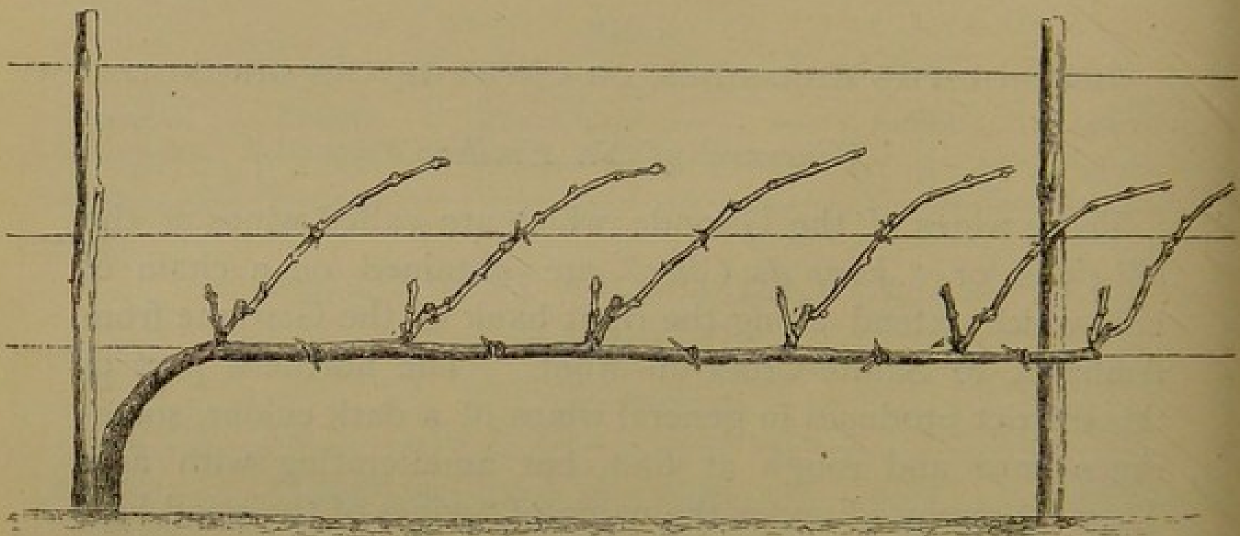


FIG. 59—Vine as trained in the Saint Emilion district and in the Palus of the Fronsadais. Six viticultural elements upon one foot.

of the Médoc. These vines are represented at Saint Emilion in the proportion of one-third each. We opine that the finesse of the Saint Emilion is derived from the Cabernet—its body and lasting quality from the Merlot—and the particular fiery and fresh quality from the Noir de Pressac. The vine here is trained from blind canes. It is arranged so as to have several arms; and on the whole this mode of cultivation is very similar to the so-called basket cultivation of the Rheingau. The cutting is performed in November and December. The Noir de Pressac is cut so that only short spurs are left. The Bouchet and the Merlot, however, are cut with long canes. The turning of the soil is mostly done with the hoe, but in some large properties the plough is used, as in the Médoc. The vines are tied to stakes, which here bear the peculiar name of *carassonnes*. When the shoots are well developed, the superfluous ones are cut off. The young planted vines commence bearing fruit in the fifth year. In the sixth year they are supposed to be in full bearing. A hectare of the best vineyards yields about six barriques; that is, thirteen and a half hectolitres per hectare. The common vineyards yield double that quantity. The vintage generally takes place from the 15th of September to the 10th of October. It lasts generally fourteen or twenty days. The vats in which fermentation takes place are all made of oak,

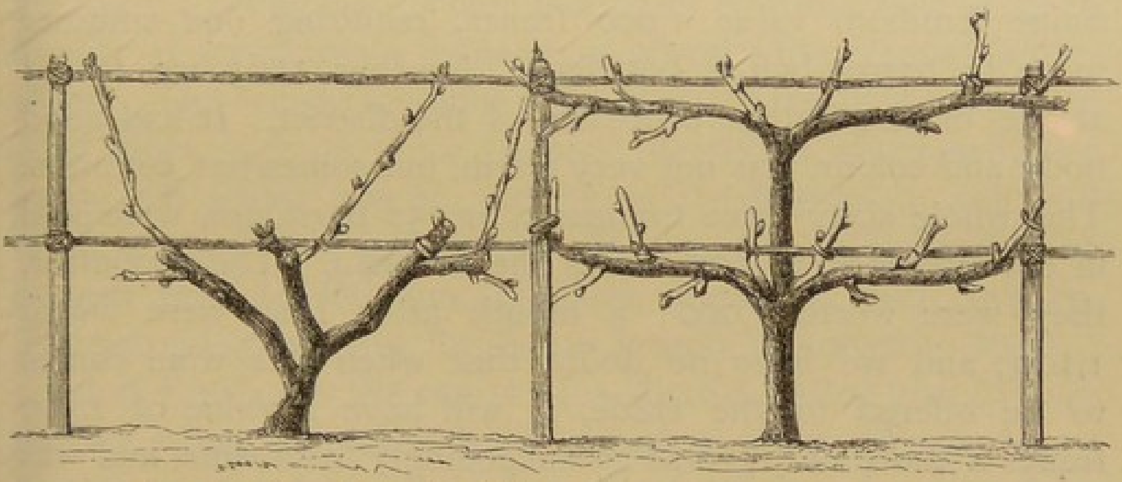


FIG 60.—Vines of the Palus (Villenave d'Ornon) pruned or spring-growth.

and contain twelve, twenty-four, or forty-eight barriques. The middle-sized vats are preferred. They are not covered during fermentation. Most proprietors crush the grapes before putting them into the vats, and a few also remove the stalks. The vatting is continued for eight days. In warm seasons and ripe years, fermentation may be over in four days. When drawn from the vat, the wine is put in new barrels, and there quickly becomes clear. After this, the barrels are all filled to the bung, closed and laid so that the bung is at the side, and entirely covered by the wine. The racking is effected in spring, and the sales begin immediately afterwards. As all operations are here performed with great care, an average of good wine is produced, which is generally easily sold. Where the wine has not good keeping qualities, the filling up of the ullage of the barrels during the first year is done once a week, and the barrels are not placed sideways until after the first year. Again, in other years, where the wine is very rich, the filling-up is continued for about eighteen months or two years, once a week, and the barrels are put sideways only after two years. Saint Emilion of good quality can be put in bottle towards the fourth year, and must under all circumstances be bottled by the sixth year. This is the technical rule of the trade. From our own experience, however, we believe that the traders of Bordeaux are ill-advised as to the time at which the Saint Emilion ought to be bottled. We tasted the 1865 Saint Emilion, value 1,000 francs, requiring one summer more in barrel before bottling. Another 1865 we tasted at one of the largest châteaux of the district. It had good body and colour, was not very warm, but somewhat common. The whole sixty-three tonneaux, or 252 barriques, were sold in our presence at 900 francs the tonneau. The day after, they were worth 1,000; a month after, they were worth 1,100; and we have no doubt that when this wine comes to be offered to the trade, it will have a value of 1,500 francs a tonneau. It was an exceedingly fresh wine, and was said to require two more years in barrel, and then two years in bottle; so that, consequently, it would not be at its best until six years after our tasting it. At Lacussaude, we tasted 1865, at 2,000 francs the tonneau; and 1864, at the same price. The latter was the preferable wine, which is a curious circumstance, as throughout the Médoc, and many other parts of the Gironde, all the 1864 without exception, are inferior to the 1865. We must add that what we said of the merchants of Bordeaux, and their habit of bottling the Saint Emilion, applies in a much stronger manner to the Saint Emilion district; for whenever we drank Saint Emilion bottled by the proprietors it was found to have become lean (*maigre*): that is to say, the wine having been left in barrel too long, had lost fruitiness, freshness, flavour, and colour, and become incapable of producing in the bottle that fragrance which it would have obtained had it been bottled a year or two earlier. We think, therefore, that Saint Emilion would not be hurt so much if it were bottled a little too early, and that it is certain to suffer a great deal if it is bottled too late. It is singular that the Saint Emilion wine is not liked in England, while one would suppose from the general taste of the English wine-drinking public that they would take to it with pleasure, for the Saint Emilion, like the best Montpelier, recalls many of the finest qualities of fine port wine, leaving the sugar and brandy out of the question : and we hope that by directing attention to the Saint Emilion, and to its peculiarities and qualities, we may contribute to help oinophilists to an enjoyment of which they are at present robbed by what we think a prejudice. There is a Saint Emilion wine of good quality at 300 francs a tonneau, or seventy-five francs the barrique. The second qualities are sold at 150 francs the tonneau. Fine wines, such as those we have described above, will not easily sell under 300 to 350 francs the hogshead, and will come to about £16 in London. Most of the Saint Emilion at present goes to Belgium, Holland, Denmark, and Sweden. The second-class Saint Emilion is largely imported to Paris.

Saint Emilion is the centre of a district called the *Libournais*, of which Libourne is the principal town. Towards the north-west the Libournais is marked off by the river Isle. On the other side of this river is the district called *Fronsadais*, of which the principal town is Fronsac, upon the banks of the Dordogne. To the north-east of the Fronsadais is the *Blayais*, which has the town of Blaye, a fortress lying on the banks of the Gironde, for its centre. The Blayais, therefore, lies opposite the Médoc, on the banks of the Gironde. In these districts considerable quantities of red and white wines are produced. None of these are classified, but many of them, particularly in good years, are very useful. Large quantities are exported under various names, particularly across the Atlantic.

CLASSIFICATION OF THE WINES OF ST. EMILION AND ENUMERATION OF THE COMMUNES OF THE LIBOURNE DISTRICT.

(*Showing names of properties and proprietors* (*in St. Emilion*), *and number of hogsheads of wine annually produced.*)

ST. EMILION.

FIRST GROWTHS.

		Hhds.			Hhds.
Belair	Baron de Marignan.	100 to 120	La Bouygue	Laforet	40 ,, 48
Canon	Baron de Bonnival.	120 ,, 140	Malineau	Bernodote Boutin.	32 ,, 40
Closfoulet	Leperche	100 ,, 120	Les Menus	Meynot	24 ,, 32
Beau-Séjour	Carpe	80 ,, 100	La Serre	Marcon	24 ,, 32
Trois Moulins	Fourcaud-Duplessis.	60 ,, 80	Ville-Maurine	Morange	24 ,, 32
Franc-magne	Fourcaut	60 ,, 80	Le Tode	Izambert	20 ,, 24
Pourret	Fontémoing	60 ,, 80	La Couxpande	Chaperon	36 ,, 48
Lacarte	Martineau	24 ,, 32	Balestard	Du Cournet	32 ,, 40
Bellevue	Lacaze	48 ,, 60	Sansonet	Coutard	64 ,, 72
Berliquet	Pères	60 ,, 80	Soutard	Barry	220 ,, 240
La Madeleine	Chatonet	48 ,, 60	Trotte-Vieille	Dumugron	24 ,, 32
Rocqueblancan	Cantanat	48 ,, 60	Sarpe	Reynaud	48 ,, 60
St. George	Loursie	32 ,, 40	Do.	De Carle	32 ,, 40
La Sable	Puchaud	32 ,, 40	Faurie	Lavean	40 ,, 48
Pimpinolle	Chapus	24 ,, 32	Cadet	Delaage	40 ,, 48
Larcis	Ducasse	40 ,, 48	Cadet et Ponnot	Piola	80 ,, 100
Do.	Dubuch	48 ,, 60	Le Couvent	Laperche	40 ,, 48
Laclusière	Thibaut	32 ,, 40	Fond-Roque	De Mallet-Roquefort.	40 ,, 48
Moudot	Troplong	40 ,, 48	Grandes Murailles	Coste-Coly	20 ,, 24
Pimpinolle	Fayard	48 ,, 60			
Ausonne	Cantenat	40 ,, 48			

SECOND GROWTHS.

		Hhds.			Hhds.
Matras	Bourricaud	180 to 200	Au Cheval blanc.	Fourcaud-Laussac	100 ,, 120
Le Mayne	Puchaud	200 ,, 220	A Figeac	Laveine	160 ,, 180
La Graffelière	Boitard	160 ,, 180	Bragard	Guadet	200 ,, 280
Do.	De Malet	120 ,, 140	A la Gomerie	Descorde	48 ,, 60
J. Faure	Penaud et Paichan.	200 ,, 220	Peyraud	Beylot-Mathieu	180 ,, 200
A Courbin	Héritiers Chaperon.	120 ,, 140	Badette	Barry	120 ,, 140
A la Gomerie	Dutour	100 ,, 120	Cautet	David	100 ,, 120
Au Canton	Do.	100 ,, 120	La Closure	Grelon	60 ,, 80
			Les Menus	Pistouley	24 ,, 32
			Gamus	Gisa	48 ,, 60

COMMUNES OF THE LIBOURNAIS.

	Hhds.		Hhds.
Les Billaux	640 to 720	Frousac	8800 to 10400
Pommerol	1600 ,, 2000	Larivière	1200 ,, 1400
Izon	4800 ,, 5600	Villegouge	3600 ,, 4000
Naujeon et Portiac . .	2400 ,, 2800	Galgon et Queynac . .	4800 ,, 5200
Curson	680 ,, 800	Guitres	800 ,, 1000
Dardinac	640 ,, 700	St. Denis de Piles . .	6000 ,, 7200
Moulon	6000 ,, 8000	Bayas	2800 ,, 3200
Castillon	2800 ,, 3200	Lapouyade	1000 ,, 1200
Sainte-Terre	400 ,, 480	St. Christophe de Bardes	1800 ,, 2400
St. Etienne de Lissé .	3200 ,, 3600	Puyssequin	2400 ,, 3200
Les Peintures . . .	1400 ,, 1600	Pujols	1200 ,, 1600
St. Médard	600 ,, 720	St. Vincent de Paule .	3600 ,, 4400
Pincuilh	760 ,, 800	St. Jean de Blaignac .	1400 ,, 1600
Ligneux	600 ,, 800	Coubeyrac	1000 ,, 1400
St. Quentin de Caplong	1200 ,, 1400	Doulezon	720 ,, 960
St. Avid de Morion .	1000 ,, 1200	St. Radegonde . . .	800 ,, 900

VITICULTURAL STATISTICS OF THE DISTRICT OF BLAYE (BLAYAIS).

(*Showing under the name of each commune the names of the proprietors of vineyards, and the average number of hogsheads of wine annually produced.*)

BLAYE.

First Growths.

		Hhds.			Hhds.
harron (St. Martin) . .	Flandrex . .	600 to 800	Ch. Lagrange (Blaye).	Marquis de Lagrange .	200 to 240
uillonet (Eyrans) . . .	Lalande . .	320 ,, 400	Saugeron (do.).	Ollière . . .	200 ,, 240
abarre (St. Martin) . .	St. Guirons .	280 about.	Cap de Haute, (do.) . . .	Gellibert . .	160 ,, 200
es Alberts (Mazion) . .	Binaud . . .	240 to 320	Lecoune - Taillasson.	Viscountess Lalande . . .	140 ,, 160
			Bellevue (Plassac). . . .	Binaud frères	140 ,, 160

Second Growths.

		Hhds.			Hhds.
azeau (St. Paul) . . .	B. de Favière .	320 to 360	Labrousse (St. Martin) . .	Labadie . .	320 to 400
es Chaumes (Mazion) . .	Lapeyre (Veuve)	200 ,, 240	Cône. . . .	Sebileaux frères	400 ,, 480
igot, (do.) .	Bardon . . .	200 ,, 240	Maime - Boye (Cars) . .	Lalande . .	400 ,, 480
amothe (Eyrans) . . .	Count d'Isle .	240 ,, 280	Lacrouzette (Blaye) . .	Tourné . . .	120 ,, 160
ontuzet (Plassac).	P. de Lagaucherie . . .	280 ,, 320	Touvent, (do.) .	Bordes (Veuve)	200 ,, 240
			Cluzeau (Cars)	Castets . . .	240 ,, 320

SECOND GROWTHS—*continued.*

		Hhds.			Hhds.
Pey-Bonhomme (Cars).	Brun	140 to 160	Four (Four)	Tardy	120 to 160
Crusquet (Cars)	J. Dupeyrat	160 ,, 190	Puynard (Berson)	Binaud frères	240 ,, 280
Lescadre (do.)	Carreau	280 ,, 320	Bedou (Cars)	Merlet	200 ,, 400
LaMetairie(do.)	Cantegril	280 ,, 320	St. Genès (St. Genès)	Do.	480 ,, 600
Pardaillan (do.)	E. Dupeyrat	240 ,, 280	Mazerolle(Cars)	Do.	200 ,, 400
Le Chay (do.)	Lalande	200 ,, 240	Gazin (Plassac)	Do.	240 ,, 320
Chante-Allouette (Cars)	Lalande	200 ,, 240	LeBourg(Four)	Do.	480 ,, 600
Boisset(Berson)	Favereau	120 ,, 160	Les Hymonants	Lafond-Binaud	400 ,, 480
Mendoce (Plassac).	De Laulanié	240 ,, 320	Lafou	Ollié	240 ,, 320

PRIGNAC.

	Hhds.		Hhds.
Castanet	600 to 800	Geraud	240 to 280
De Saluces	200 ,, 240	Artaud	48 ,, 60
Bayez	80 ,, 120	Cavignac	40 ,, 48

GAZELLE.

	Hhds.		Hhds.
De Soyres (avec son bien de Labarde)	240 to 280	De Saluces	200 to 240
		Donis	40 ,, 48

BOURG.

	Hhds.		Hhds.
Vte. Du Barry	200 to 280	Etienne	40 to 60
Peychaud	100 ,, 120	Dusseau	100 ,, 120
Ve. Courpon	320 ,, 360	Boudrefox	40 ,, 60
Charlus-Barbier	460 ,, 480	Magol	40 ,, 48
Lamons	40 ,, 48	Aillard	40 ,, 48
Sicard	40 ,, 60	Labourdetto	48 ,, 60
Subercazeaux	80 ,, 120	Subercazeaux	60 ,, 80
Guyard	80 ,, 100	Pastoureau	48 ,, 60
Galice (Veuve)	48 ,, 64	De Chal	40 ,, 60
Faure	80 ,, 100	Durneynion	80 ,, 100
Despaignet	60 ,, 100	Dumesnil	60 ,, 80
Latreille	80 ,, 100	Jagou	60 ,, 80
Marsaud	60 ,, 80	Texier	40 ,, 48
Célerier	140 ,, 160	Mallard	40 ,, 48
Lafitte	80 ,, 100		

CAMILLAC.

	Hhds.		Hhds.
Gilbert	140 to 160	Joubert	100 to 120
Peychaud	48 ,, 60	Allard	60 ,, 80
Leydet d'Aubie . . .	48 ,, 60	Audutau	48 ,, 60
Pascault	80 ,, 100	Peychaud, à St. Seurin .	40 ,, 48

LA LIBARDE.

	Hhds.		Hhds.
Bertaud	100 to 120	Peychaud	60 to 80
Berniard, jun.	40 ,, 48	Héritiers Labadie . . .	60 ,, 80
Berniard-Cassade . . .	60 ,, 80	Bertrand, L.	40 ,, 48
Renaud	80 ,, 120	Berniard	40 ,, 48
Montbrun	140 ,, 160	Labourdette	60 ,, 80
Allard	40 ,, 48	Dumeynion	40 ,, 48
Noël	80 ,, 120	Mellard	40 ,, 60
Raganeau	60 ,, 80		

BAYON.

	Hhds.		Hhds.
Marsaud, à Tayac . .	360 to 488	Bonnefon	32 to 40
Viaud, à Eyquem . . .	280 ,, 360	Blay	80 ,, 120
De Chasteigner . . .	240 ,, 320	Bénassit	24 ,, 40
Goyeau, à Blissac . .	240 ,, 320	Drouilhard (Veuve) . .	28 ,, 40
Ribadieu, à Millorit . .	160 ,, 240	Pierlot	400 ,, 640
Grimard	120 ,, 160	Baillon	60 ,, 80
Duranthon	40 ,, 60	Roturier (Veuve) . . .	60 ,, 80
Goujon	40 ,, 80	Laroussie (Veuve) . .	60 ,, 80
Cailleux	60 ,, 80	Laroussie	28 ,, 40
G. de Laborie	80 ,, 100	Rochet	40 ,, 60
Malembie	80 ,, 100		

GAURIAC.

	Hhds.		Hhds.
Viaud	160 to 200	Emery	140 to 160
Chambord	80 ,, 100	Mitubert	48 ,, 60
Pastoureau	160 ,, 200	Charruand	40 ,, 48
Depoty (Veuve) . . .	40 ,, 48	Cousteau	60 ,, 80
Deschamps	160 ,, 180	Laudard	40 ,, 48
Allard	48 ,, 60	Migne	48 ,, 60
Veuve de Jean Allard .	48 ,, 60	Goiseau	48 ,, 60
Barril	180 ,, 200	Bichon	320 ,, 400
Faugères	48 ,, 60	Lourget	320 ,, 400
Roy frères	80 ,, 100		

VILLENEUVE.

	Hhds.		Hhds.
Baron de Brivazac . .	160 to 760	Sinau, G.	60 to 80
Dechand	80 ,, 120	Roy	48 ,, 60
Goize	160 ,, 200	Graveraud	48 ,, 60
Laulane	280 ,, 400	Bellue	48 ,, 60
Sinau	60 ,, 100	Gourdet	60 ,, 100
Blay	220 ,, 320	Eymery	40 ,, 60
Grimard	40 ,, 80	Bouvet	40 ,, 48
Briand	40 ,, 80	Landard	40 ,, 48
Février	60 ,, 100	Héraud	32 ,, 40
Sinau	60 ,, 80	Étier	24 ,, 32
Chaillon	12 ,, 16	Despinasse	160 ,, 240
Bernard	20 ,, 24	Arnaud	120 ,, 160
Duret	12 ,, 16		

SAMONAC.

	Hhds.		Hhds.
Héritiers Sunder . . .	400 to 640	Veuve Héraud	60 to 80
Gaignerot	160 ,, 200	Sou, M.	60 ,, 80
Gayet	160 ,, 200	Renard Cadet	60 ,, 80
Charroppin	180 ,, 200	Auduteau	40 ,, 60
Héritiers Janvier . . .	120 ,, 140	Gaudrie	40 ,, 60
Cavignac	80 ,, 100	Cannaud	40 ,, 60
Sou, P.	60 ,, 80		

ST. SEURIN DE BOURG.

	Hhds.		Hhds.
H. de Bellot	120 to 160	Labourdète	60 to 80
Berthaud	80 ,, 120	Bayard	40 ,, 48
Dupuy	80 ,, 100	Paquier	40 ,, 60
Peychaud	60 ,, 80	Poirié (Veuve)	40 ,, 60
Dumeynieu	60 ,, 80	Clou	40 ,, 60
Dupayrat	60 ,, 80	Roy	40 ,, 60

COMPS.

	Hhds.		Hhds.
Paty	160 to 200	Roy, J.	40 to 48
Pauvif	80 ,, 100	Bayard	40 ,, 48
Roy (Veuve)	40 ,, 48	Duranthon	40 ,, 48
Garnier	120 ,, 160	Fauré	48 ,, 60
Cailleux	80 ,, 100	Etiez	48 ,, 60
Dusson	48 ,, 72		

ST. CIERS DE CANESSE.

	Hhds.		Hhds.
Deschamps, à la Erolet	320 to 400	Gravereau	100 to 140
Largeteau, à Guibonnet	320 ,, 400	Eymerit	100 ,, 120
Abiet, aux Adouins	120 ,, 160	Hérit., à Berbillot	100 ,, 120
Laveaux, au Sclaponier	120 ,, 160	Degarde, do.	100 ,, 120
Demons, au bourg	120 ,, 160	Laveaud	100 ,, 120
Plumeau, à Perroland	120 ,, 160	Dulorier	100 ,, 120
Garceau, à Berbillot	60 ,, 80	Quimeaud	80 ,, 104
Maurin, aux Arneaud	60 ,, 80	Dulaurier (Veuve)	40 ,, 48
Roy, do.	60 ,, 80	Étier	40 ,, 48
Sinau, à Bitot	60 ,, 80	Héreaud	40 ,, 48
Lemeau-Nestor	48 ,, 60	Héreaud, à Guibonnet	40 ,, 48
Rousset	48 ,, 60	Héreaud	80 ,, 120
Arneaud	160 ,, 200	Selou	40 ,, 48
Boyer	40 ,, 60	Sou	40 ,, 48
Charlot	40 ,, 48		

VITICULTURAL STATISTICS OF THE DISTRICT ON THE RIGHT BANK OF THE GARONNE, PRODUCING WHITE WINES.

(*Showing under the name of each commune the names of proprietors and the number of hogsheads of wine annually produced.*)

BAURECH.

	Hhds.		Hhds.
Roujol	320 to 400	Damesnil	48 to 60
Sorbe (Veuve)	480 ,, 600	Calvé et Técheney	60 ,, 72
De la Chassaigne	320 ,, 400	Larrieu	48 ,, 60
De Lambert-Desgranges	280 ,, 320	Lespagne	48 ,, 60
Boyrie	200 ,, 240	Ferchaut frères	40 ,, 48
De Labadie	140 ,, 180	Vincent	60 ,, 80
De Lafaye	140 ,, 160	Géraud	32 ,, 40
Ferchaut	160 ,, 200	Deneuville	48 ,, 60
De Laprade	200 ,, 240	Videau	40 ,, 48
De Labordère	140 ,, 160	Bourdère, P. and B.	60 ,, 80
Decanole	120 ,, 140	Dauben	24 ,, 32
Vitrac	80 ,, 100	Fieux	32 ,, 40
L'Hôtelier	60 ,, 72	Héritiers Fénélon	48 ,, 60
Ab. de Lacaussade	60 ,, 80	Cadix-Rémond	32 ,, 40
Héritiers de G. de Lacaussade	80 ,, 100	Phillippe	28 ,, 36
Labadie de Lalande	24 ,, 32	Pareau	32 ,, 40
Coullaud	32 ,, 40	Héritiers de J. Ricard	40 ,, 48
Lafitte	60 ,, 72	Sundry small proprietors	160 ,, 200

TABANAC.

	Hhds.		Hhds.
G. de Gaulne	800 to 1000	De Lacaussade . . .	80 to 100
Roujol, sen.	440 ,, 480	Renou	80 ,, 100
Valette	440 ,, 480	Lataste	80 ,, 100
S. de Lognac	290 ,, 400	Blanc	80 ,, 100
Clauzel	300 ,, 320	Grosselié	60 ,, 80
De Laprade	240 ,, 260	Queyrus	48 ,, 60
De Longuerue	120 ,, 160	Sundry vineyards under 48 hhds.	1000,, 1040
Dupuch	100 ,, 120		
Lacoste	100 ,, 120		

LE TOURNE.

	Hhds.		Hhds.
P. Gentin (Château de Pie)	260 to 280	Balin (Veuve)	48 to 60
Cazaux (Domaine de la Ronde)	200 ,, 220	Laville	80 ,, 100
Laclaverie	48 ,, 60	Bertin	120 ,, 140
Cazeau	60 ,, 80	Vincent	80 ,, 100
Lescours	60 ,, 80	Sundry growths under 40 hhds.	400 ,, 480

LANGOIRAN.

	Hhds.		Hhds.
Faux	240 to 280	Azera (Veuve)	60 to 80
Chaize (Veuve) . . .	160 ,, 200	Bedro (Veuve)	60 ,, 72
Devèze	160 ,, 200	Sabés	48 ,, 60
Dureau	160 ,, 180	Caussade	48 ,, 60
Merlande (Veuve) . .	120 ,, 160	Bourdelles frères . . .	48 ,, 60
Dumas	120 ,, 160	Demptos frères . . .	48 ,, 60
De Ramond	140 ,, 160	Labroue	48 ,, 60
Gazeau	80 ,, 100	Ferchaut	48 ,, 60
Andrieu	100 ,, 120	Coëffen	40 ,, 48
Desbats	100 ,, 120	Mandé	40 ,, 48
Lupsol	100 ,, 120	Gassiot	40 ,, 48
Gauvry	100 ,, 120	Joly	—
Tarteyron	100 ,, 120	Sundry other vineyards, producing under 40 hhds.	800 ,, 1000
Virvalois (Veuve) . . .	80 ,, 100		
Erbens	60 ,, 80		
Roux	60 ,, 80		

LESTIAC.

	Hhds. Red.	Hhds. White.		Hhds. Red.	Hhds. White.
Raffet	220	100	Hellies, sen.	60	20
Despagne	80	40	Hellies	40	40
Léglise	60	60	Bergés	60	—
Itey frères	60	40	Bourdelles	60	—
Hellies	60	20	Dubroqua	40	20
Helles, E.	40	40	Dandieu	40	20
Cadillon	80	—	Faux	40	20
Baillon-Pérot	40	40	Baillon	60	—

LESTIAC—*continued.*

	Hhds. Red.	White.		Hhds. Red.	White.
Hellies, F.	40	20	Castaing	—	40
Lassagne-Lahorre . . .	40	20	Duman	40	—
Charouseil	—	60	Vignes	40	—
Carauté	40	20	F. Hellies	40	—
Piganneau	60	—	Ducros frères	40	—
De Melet	40	—	Gauthier	40	—
Lagune	—	40			

PAILLET.

	Hhds.		Hhds.
Monsarrat	320 to 400	Abraham	40 to 48
Bousbon	320 ,, 400	Dumas	40 ,, 48
Desbats	180 ,, 200	Jannaut	40 ,, 48
Cousseux	100 ,, 120	Gros	40 ,, 48
Couronneau	100 ,, 120	Rousset	40 ,, 48
Sadran	80 ,, 100	Dumas (Veuve) . . .	32 ,, 40
Cuttoli	48 ,, 60	Gros	32 ,, 40
Sauteyron	48 ,, 60	Cousseau	32 ,, 40
Lahille	48 ,, 60	Beynis	32 ,, 40
Rieutord (Veuve) . . .	48 ,, 60	Briol	32 ,, 40
Garaud	48 ,, 60	Sundry growers, producing under 40 hhds. .	600 ,, 680
Ducros	40 ,, 48		
Vignes	40 ,, 48		

RIONS.

	Hhds.		Hhds.
Lacombe	240 to 280	Dorgueuilh	80 to 100
Constantin	240 ,, 280	Garaud	72 ,, 88
De Gères	220 ,, 240	Darcos-Guy	72 ,, 88
Péry	200 ,, 220	Mathereau	72 ,, 88
De Galard	200 ,, 220	Bourdelles (Veuve) . .	60 ,, 80
Labarthe	200 ,, 220	Arnaud d'Armiche . .	48 ,, 60
Mutel	180 ,, 200	De Caupenne	48 ,, 60
Roussereau	120 ,, 140	Aribaud	48 ,, 60
De Peyronnin	120 ,, 140	Léglise	48 ,, 60
Garaud	100 ,, 120	Gassiot-Autapis . . .	48 ,, 60
Desessard	100 ,, 120	Gaudin	48 ,, 60
Briol	100 ,, 120	Taudin	48 ,, 60
Videau	100 ,, 120	Silliman	40 ,, 48
Martin	100 ,, 120	Sensine	40 ,, 48
Les Carmes	100 ,, 120	Sedrac-Merle	40 ,, 48
Bordes	100 ,, 120	Samonayre	40 ,, 48
Héritiers Thibaud . .	80 ,, 100	Tallet	40 ,, 48
Dumas	80 ,, 100	Carasset	40 ,, 48
Fourcassies-Éliés . . .	80 ,, 100	Clarens	40 ,, 48
Vidau-Piscaut	80 ,, 100	Restouilh frères . . .	40 ,, 48
Cazentre	80 ,, 100	Pène	40 ,, 48

BÉGUEY.

	Hhds.		Hhds.
Médeville	320 to 360	Grangey (Veuve) . . .	40 to 60
De Parroutz	200 ,, 240	D'Autin (Veuve) . . .	48 ,, 60
Laspeyrères	160 ,, 200	Charriaud	48 ,, 60
Chiapella	120 ,, 160	Gassies	48 ,, 60
Maydieu	120 ,, 140	Dupuy	40 ,, 48
Brostaret	100 ,, 120	Chatellier	40 ,, 48
Redeuilh	100 ,, 120	Béziat	40 ,, 48
Médeville	100 ,, 120	Brousse	40 ,, 48
W. de Wormilly . . .	100 ,, 120	Boudinot	40 ,, 48
Pouchan	80 ,, 100	Videau	40 ,, 48
Simon	80 ,, 100	Espilère	40 ,, 48
Redeuilh, H.	60 ,, 80	Smaller growers . . .	400 ,, 480

CADILLAC.

	Hhds.		Hhds.
Desbats	400 to 480	Richet	60 to 80
Baudet	140 ,, 160	Fourcassies	180 ,, 200
Bonneval	120 ,, 140	Beziat	60 ,, 80
Dupart	100 ,, 120	C. Bernachet	48 ,, 60
Baret	100 ,, 120	Carasset	48 ,, 60
Worms	100 ,, 120	Médeville, L	48 ,, 60
Mernais-Tillhet . . .	80 ,, 100	Médeville, sen.	48 ,, 60
Médeville	80 ,, 100	Boisson.	100 ,, 120
Cazeaux	80 ,, 100	Bonnefoux	48 ,, 60
Moreau	80 ,, 100	Faurie	48 ,, 60
Mathelot	80 ,, 100	Riaubert	40 ,, 48
Homau	80 ,, 100	Fouquet	40 ,, 48
Dupouy	60 ,, 80	Lataste	40 ,, 48
Dubacquier	60 ,, 80	Tauzin	40 ,, 48
Augey	60 ,, 80	Sundry growers . . .	600 ,, 680
Mathelot, sen.	60 ,, 80	Fouquet, M.	40 ,, 48
Mutel	60 ,, 80		

LOUPIAC.

	Hhds.		Hhds.
Lachassagne	200 to 240	Cluzaut	80 to 100
Leuger	120 ,, 140	Meyssac	80 ,, 100
De Marcellus	100 ,, 120	Guérin	60 ,, 80
Courèges	100 ,, 120	Promis	72 ,, 80
Goineau	100 ,, 120	Boré	60 ,, 80
Mingaud	80 ,, 100	Fonvielle	48 ,, 56
Dezeimeris	160 ,, 200		

ST. CROIX DU MONT.

	Hhds.		Hhds.
Lafon	160 to 200	De Marbotin	100 to 120
De Rolland (Château Lamarque, half white and half red)	560 ,, 600	Bayle	120 ,, 140
		Garret	120 ,, 140
		Andrie	200 ,, 220
Turman	180 ,, 200	Lépine	48 ,, 60
Gensounet-Feuillard . .	40 ,, 48	Boucherie	120 ,, 140
Dresky	100 ,, 120	Mazet (Veuve)	100 ,, 120
Vignal	100 ,, 120		

VITICULTURAL STATISTICS OF THE DISTRICT OF THE MARSHES (PALUS, ENTRE DEUX MERS).

(*Showing under the heading of each community the names of the properties and proprietors, and the number of hogsheads of wine annually produced.*)

PREMIÈRES PALUS.—*First Section.*

WINES OF QUEYRIES.—FIRST GROWTHS.

		Hhds.			Hhds.
Lambert . .	De Moyencourt	60 to 100	Jones . . .	Nard . . .	40 to 48
Farouil . . .	Bouthier . .	80 ,, 120	Pineau . . .	De Pineau .	100 ,, 120
Silvestre . .	Gallier . . .	72 ,, 80			

SECOND GROWTHS.

		Hhds.			Hhds.
Millas . . .	Bichon . . .	140 to 160	Pêche . . .	Balguerie . .	120 to 144
Lachabanne .	Hourquebie .	144 ,, 152	— —	Chiapella . .	60 ,, 80
Peixotto . . .	Samouillan .	48 ,, 56	— —	Martin . . .	80 ,, 96
Luques . . .	Brumereau .	80 ,, 88	— —	Delezé . . .	60 ,, 80
Lauzac . . .	Faure . . .	88 ,, 100	— —	Fatin . . .	80 ,, 100
Navarre . . .	Lalande . . .	24 ,, 28	— —	Aubert . . .	120 ,, 160

Second Section.

		Hhds.			Hhds.
Pineau . . .	De Pineau . .	80 to 100	Navarre . . .	Lalande . . .	56 to 64
Pleu	Feaugas . . .	80 ,, 100	Peixotto . . .	Samouillan .	104 ,, 112
Béhcade . . .	Bouthier . .	140 ,, 160	Lacan . . .	Dasvin . . .	32 ,, 40
Delezé . . .	Galtier . . .	80 ,, 100	Pêche . . .	Balguerie . .	64 ,, 72

DEUXIÈMES PALUS.

At Montferrand.

	Hhds.		Hhds.
Lafon	80 to 100	Gonzalès	160 to 200
Planteoigne	200 ,, 240	Gradis	400 ,, 480
De la Seiglière . . .	200 ,, 240	Groulié	80 ,, 120
Aymon	80 ,, 120	Lapeyre	160 ,, 240
H. Devès	160 ,, 240	De Lignac	140 ,, 160
Kleber-Dulac	200 ,, 240	Maccarthy	80 ,, 120
P. and A. Raba . . .	160 ,, 240	Maillère et Mories . .	400 ,, 600
Meller, A.	560 ,, 600	Veuve Molescaut . . .	100 ,, 160
Troplong	120 ,, 140	Bourdil	120 ,, 160
Meller, A.	480 ,, 600	Ducasse	160 ,, 200
Brannens	320 ,, 400	Mengar	80 ,, 100
Castoneau	160 ,, 200	Promis-Bousquet . . .	200 ,, 240
Courtès	160 ,, 240	Delisse-Carmes . . .	200 ,, 240
H. Devez	120 ,, 200	Chariol	72 ,, 80
D. de Sigalas	120 ,, 240	Louradour	80 ,, 100
T. Dupuy	120 ,, 160	De Furnel	100 ,, 120
E. Duroy	200 ,, 280	Chalus	48 ,, 60
Gagneron	240 ,, 320	Pontet	48 ,, 60

At Bassens.

PALUS.

	Hhds.		Hhds.
Ladonne	280 to 300	Veuve Guillori	120 to 140
Frimois	240 ,, 260	Bichon	120 ,, 140
Paria	240 ,, 260	Daëne	100 ,, 120
Veuve Rodrigues . . .	160 ,, 180	D. de Siglas	92 ,, 112
Guillori	140 ,, 160	Chaigneau	92 ,, 100
Ferrière	140 ,, 160	Sterling	80 ,, 100
De Montbrun-Lavalette .	140 ,, 160	Duroy	80 ,, 100
Mann	140 ,, 160	Veuve Clavel	80 ,, 100
Steiner	120 ,, 140	Veuve de Sarreau . . .	80 ,, 96

TERRAINS.

	Hhds.		Hhds.
Durand	360 to 380	Espinasse	140 to 160
De Villepreux	320 ,, 360	R. de Lussan	120 ,, 140
Digne	260 ,, 280	Veuve Bonnet	120 ,, 140
Bichon	240 ,, 260	Lacaze	160 ,, 200
Rochefort	220 ,, 240	Veuve du Frémont . .	100 ,, 120
Fabre	180 ,, 200	De Sarreau	100 ,, 112
Drouet	140 ,, 160	Veuve Hauchecorn . .	100 ,, 112
Barre	100 ,, 160	Larraud	96 ,, 112
Petit	140 ,, 160	Veuve Goudin	96 ,, 104
Leutz	140 ,, 160	Veuve Goujes	80 ,, 100

TROISIÈMES PALUS.

Quinsac.	St. Gervais.
Camblanes.	Les Valantons.
Bouillac.	Bacalon.
Ambes.	

QUATRIÈMES PALUS.

Macau.	St. Loulès.
La Tresne.	Ison.
Beautiran.	

CINQUIÈMES PALUS.

St. Gervais.	Asque.
Culzac.	L'Ile St. Georges.
St. Romain.	

CHAPTER XI.

WINES OF ROUSSILLON AND LANGUEDOC.

WINES OF ROUSSILLON, THE ORIENTAL PYRÉNÉES: Topography and varieties of vines.—Mode of cultivation.—Mode of making the Muscat wine.—Mode of making the Malvoisie and Maccabeo wines.—Vineyard of Perpignan.—Recapitulation of the wines of Roussillon.—Shipment of the wines of Roussillon.—WINES OF LANGUEDOC: Topography.—Soil.—Of the vines cultivated.—Terret-noir, Terret-bouret, Aramon, Œillade, Aspiran.—Cultivation of the vine.—Secateur; Vintage; Yields; Vinification.—Distinguished growths of the Department of the Aude.—Ditto of the Gard.—Langlade.—St. Gilles.—Vinification at St. Gilles.—White wines of St. Gilles, how made.—The remarkable growths of the Hérault.—Muscat wines.—Frontignan.—Lunel.—Manufacture of Troissix and Eau-de-vie at Montpelier.

ROUSSILLON, THE ORIENTAL PYRÉNÉES.—TOPOGRAPHY AND VARIETIES OF VINES.

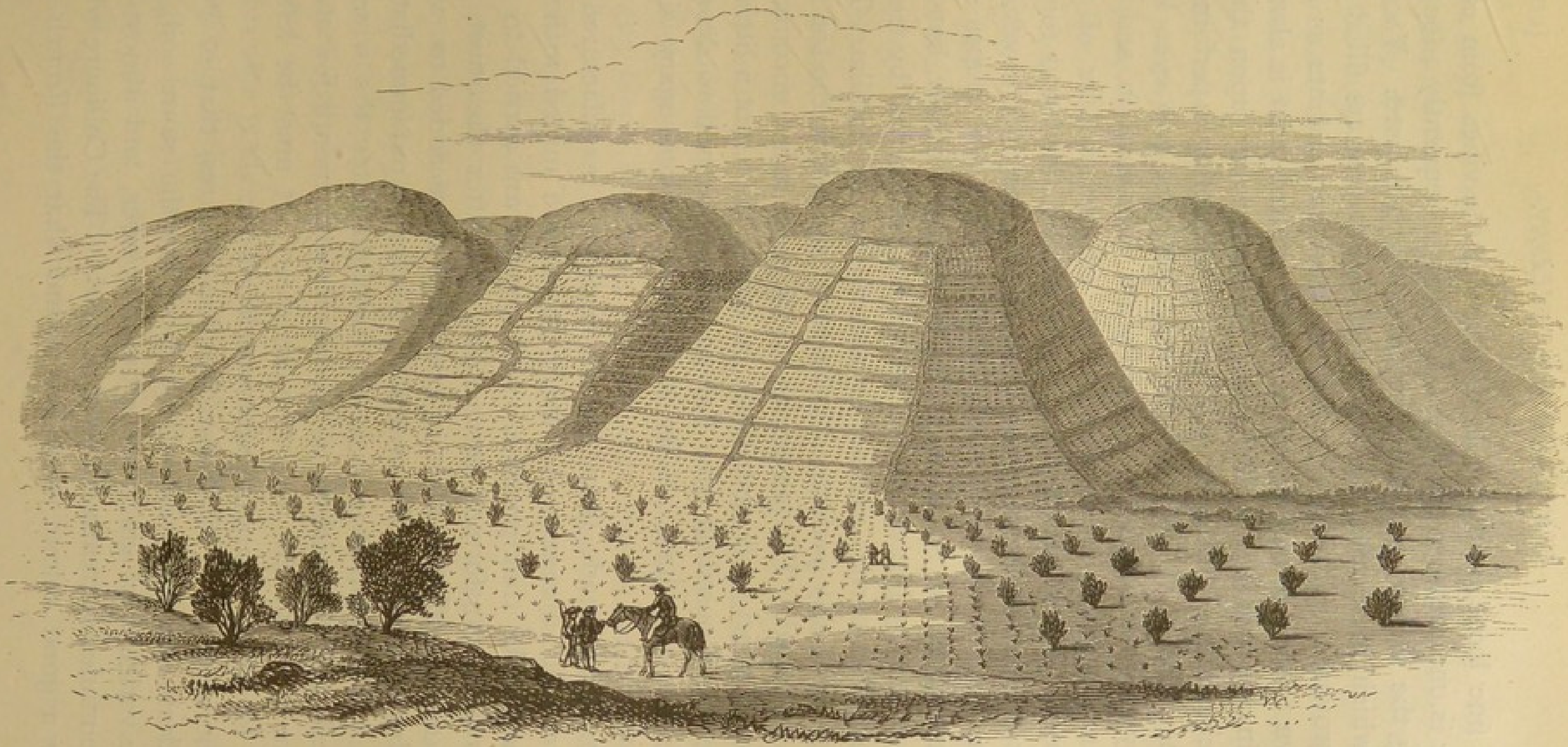
ROUSSILLON is the name of an ancient province of France now merged in the department of the Oriental Pyrénées. Its name has been preserved by its wines, and certainly its wines were, and in part are yet, its only or principal wealth. There are here more than 50,000 hectares of vineyards. Three kinds of wine are produced—liqueur wines, dry wines, and wines which are in such a condition that they can be used for the manufacture of anything—factitious port in particular. It is to the fortified wines—particularly red wines—that Roussillon owes its reputation. The most celebrated vineyards of the district are those of Banyuls-sur-Mer, Collioure, Port-Vendres, Rivesalte, and Perpignan. Banyuls-sur-Mer is very near the Spanish frontier, in the warmest part of the Eastern Pyrénées, and has an area of about 4,500 hectares.

Most of the vineyards are on slopes. The lower ones situated in the plain are on alluvial soil. The slopes are schistose.

The prevailing vines, almost the exclusive vines of the district, are the Grenache noir and the Carignane. The Grenache is almost always planted on the heights, and that in the whole of the Roussillon district. This vine is recognized by the light-brown colour of the one year's wood, bearing black points, and dark brown stripes. The nodes are strongly thickened and large, a little darker than the wood, and stand close together. The leaves are well developed, three-lobed, and of a lively green. The grape is large, loose, most frequently pyramidal, but with uneven berries, and otherwise deformed by accident during blossom time. Its colour is bluish black. It is covered with a strong bloom, and has a fine taste, in which sweetness and perfume prevail. Its skin is thin, and it ripens early. The second variety, the Carignane, is less fertile and less delicate than the former. It grows in the lower parts of the vineyards and gives dry wine. The nodes of its canes are very close together. Its leaves are large and five-lobed, and their bays very deeply cut. It has a fine green colour. The grape is long, round, uneven, and blackish blue, and has a strong bloom. It ripens late, has a thick skin, and its taste is less sweet than that of the Grenache. The ordinary Banyuls wines are generally made of two-thirds of Grenache and one-third of Carignane grapes. There are sometimes other vines mixed with these two varieties, such as the Mataro and the Picpoule. The Mataro also bears a blackish grape, which is sweet and early. The Picpoule is a vine which occurs in several departments of the south of France, in the Bouches-du-Rhône, in the Hérault, and the Gard. These latter varieties, according to Lenoir, give only a mediocre wine.

MODE OF CULTIVATION.

The soil is deeply grubbed, generally with the mattock. Plantation is effected between December and April. Canes only are planted. A hole is made in the ground by means of an iron rod, the cane is inserted, and the hole is filled up



Fig, 61.—Vineyards of Banyuls, Port-Vendres, and Collioure. Department of the Pyrénées Orientales.

with fine loose earth. The distance of the vines from each other is one metre every way. Digging is frequently adopted along the slopes; in other parts the plough is used. Vacancies which arise after the third and fourth year are filled up by provines. Grafting is effected upon such plants as are known to be of bad quality, and the grafted joint is always put in the ground. The young vines are cut upon three branches in the third year. The ordinary cutting is performed in the winter. Upon each branch there are two eyes left. The young branches are generally not shortened in, and the surplus branches are not taken off till the middle of the summer. The vines begin to bear in their third and fourth years, and are at their best at eight or ten years. The vintage begins in the early part of October. On the slopes the hectare gives, on an average, 15 hectolitres of wine, but the plain yields 25 hectolitres. The grapes are mashed by treading, and the berries are not separated from the stalks. The cuvage is mostly performed in barrels, from which the top has been removed. The plastering of the must is not uncommon in this district, and contributes, in our opinion, not a little to make the Roussillon wine flat and mawkish, and to deprive it of that refreshing acidity which alone makes sugary wines tolerable.

The wine made from the Grenache is manufactured in a particular manner. No other grapes are mixed with the Grenache for that purpose. The grapes are carried to the press and transformed into mash, and after the must has been drawn off, two litres of proof spirit are added to every hundred litres of the liquor, and the mixture is put immediately into well-sulphured casks. A fortnight later the wine is racked, and the racking is repeated every month for about six months, till the wine remains clear. It must be left in cask for fifteen years before it can be drunk.

The vineyard of Collioure has 800 hectares, that of Port-Vendres 600 hectares. Here there are the same soil, the same varieties of vines, the same exposures, and almost the same modes of treatment as at Banyuls. The Collioure wines have a good colour, much body, and what the French call generosity, and are drier wines than the Banyuls.. By age they acquire finesse, and a pronounced bouquet. They gain much by remaining in the barrel, and they should never be bottled before they are ten years old. At that age they have lost their colour, and have become straw-yellow, or golden, and have assumed that character which the Spaniards call *rancio*. The wines in this district are generally sold shortly after the vintage, and the proprietors rarely retain even a small quantity in their cellars. Their price always is the price of new wine. The Banyuls, Collioures, and Port-Vendres sell at 15 francs the hectolitre (without barrel). At ten years old the hectolitre fetches 60 francs, at fifteen years 80 francs; and wine which is twenty years old may obtain from 100 to 150 francs the hectolitre. Most of these wines go to the United States, to be there manufactured into liqueur wines, and to the Brazils, to be drunk as dry wines. Cette and Marseilles take considerable quantities to work them up into whatever may be demanded. The vineyard of Rivesaltes is the most important on account of its size, having 10,500 hectares. Of these, one-half is on slopes and exposed to the mid-day sun. It is planted with five principal vines, of which we know the Carignane, the Grenache, the Mataro, and the black Picpoule; but another vine is peculiar, and that is the Clairette, which is also sometimes improperly called the Blanquette. This latter vine has cinnamon red canes and pale green leaves, which are three- or five-lobed. The bunches are pyramidal with wings, and among the grapes are many that are oval, half transparent, golden yellow, and bloomy, having a sugary taste and a thick skin. They ripen late, and give a fine wine, which when young is sweet, and afterwards becomes dry, and is qualified to be transformed into effervescent wine.

This vine is identical with that which in our account of the Würtzburg district we have described under the name of Hermitage. In Germany it is known under the name of white Muscat Sylvaner. We remark, however, that we have found several vines in Picardy and Limoux, and other parts of France, which were termed Clairette or Blanquette, and which were similar to, but not quite identical with, each other. Three-fourths of the vines of Rivesaltes are Carignane. This variety, together with the Mataro, gives body and colour to the wines of these parts. The Grenache added in small quantity gives softness and liveliness to the wine; but in general all the Grenache grapes are selected, and the so-called sweet black Roussillons are made of it. The plantation and treatment of the vine, and the making of the wine, are the same as at Collioure. Many of the wines go to America. In the first year they fetch 12 francs the hectolitre, in the fifth year from 25 to 30 francs. Their value is not more than 100 francs at from ten to thirty years old. It is, however, unlikely that in the present state of the science of mixing and manufacturing wines, and at the present price, any considerable quantity should attain that age. Rivesaltes makes what is called specialities which have a limited reputation. Such are the Muscat, the Maccabeo, the Malvoisie, the Grenache, and the Rancio. Of the Muscat wine at Rivesaltes about 300 hectolitres are made. They are the produce of a special variety of vine called the Muscat of Rivesaltes. The Maccabeo is also a special variety of vine, and produces about 60 hectolitres of wine which bears its name. The Malvoisie is a vine with small leaves, which are nearly round, and have the five lobes only slightly pronounced. Its grape ripens early, and of its wine about 40 hectolitres are annually made. These vines are not mixed in the vineyards with other vines, but are kept by themselves in distinct compartments of the vineyards. This seems to be particularly necessary in order to prevent the workmen from cutting them in the same style as the Grenache and the Carignane; for if this were done, they would yield very little wine.

MODE OF MAKING THE MUSCAT WINE.

The grapes are allowed to hang on the plant, or, if cut, exposed on trays to the sun until they have become shrunk and raisin-like. They are then trodden with the feet, or mashed between cylinders, the stalks not being removed, and conveyed to the press. The must which is obtained has a great density. It is put in barrels and left to itself. The barrels are not filled up, but when the fermentation is nearly complete the wine is racked. In the first year the Muscat of Rivesaltes has more resemblance to syrup than to wine, and in that respect it finds its parallel in the latest forms of the wines of Sauternes, which we have described in another chapter; but in the second year it becomes more clean, and acquires that finesse, that fire, and, above all things, that muscat bouquet, which impart to it its celebrated character. Jullien pronounces it one of the best liqueur wines of the world, provided it comes from a good year, and is old. Rendu advises that it should not be kept very long, and that it should be drunk while the perfume is fresh, for its bouquet is transient, and becomes changed with age, although, perhaps, the wine obtains other qualities at the same time. At ten years it ought to be drunk. The average price of Rivesaltes wine is from 80 to 100 francs the hectolitre.

MODE OF MAKING THE MALVOISIE AND MACCABEO WINES.

The vinification of the Maccabeo and the Malvoisie is a little different from that of the Muscat. The grapes used for them are not allowed to dry either on the vine or by themselves. The Maccabeo grape is mashed and pressed, and the juice is immediately put in a pan over the fire. When the scum is rising the liquid is allowed to cool, and is put into barrels, together with a certain quantity of proof spirit. It is racked once a month for six months. Such wine tastes of little else than sugar, spirit, and acid. In the making of Malvoisie the grapes are carried to the press with the utmost care, for it has been found that if they are at all injured they lose much of their flavour. They are immediately placed in the press, the juice obtained is put in barrels, mixed with proof spirit, and allowed to ferment as long as possible. When the fermentation has ceased the wine is racked, and a little more proof spirit is added. The wine is racked only twice during the first year. Sometimes dry Malvoisie wine is also made. In this case the berries are taken from the stalks and the juice is allowed to ferment itself out during six or seven days. We believe that in France, Germany, and England, the days of these sugar-syrup wines are over. They now go only to parts where the other so-called dry wines are little understood,—Russia and America, and where a profusion of mixtures are drunk by the higher and lower classes of the population. They are made generally of distilled spirits, sugar, and some flavoury spice and dye. The quantity of these wines produced in the South of France has never increased, small as it is; and as no wines or liqueurs are so capable of falsification as these, we believe that, in the course of time, the genuine wines will disappear; the factitious wines will hold the field, and when the world has discovered their nature, it will cease to drink them.

VINEYARD OF PERPIGNAN.

The produce of this vineyard is inferior to that of Banyuls and Rivesaltes, owing mainly to the fact that two-thirds of its 5,000 hectares are situated in the plain. The portion which lies on the slopes rises hardly a few feet above the level of the sea. The soil is clay, and in several parts chalky; and there are everywhere rolled pebbles, as in the Médoc. The vines are the same as in Rivesaltes. The vintage takes place between September 25 and October 15. The quantity of wine obtained is from 8 to 16 hectolitres per hectare. The wine is left in the cuves during 25 to 36 days. The lower classes of wines are always treated with plaster,—a practice which we have fully exposed in the chapter devoted to that subject. The white wines, if sweet, are put in bottles in March. The red wines remain in the barrels. The wines which it is intended to age are left in barrel at least fifteen years. When they are kept in glass they retain their colour, while when kept in wood they lose much of it, as is the case with port wines and others. Those wines which are kept in glass from the first, are decanted into fresh bottles after the first year, and after the second, the fourth, the sixth, the eighth, the tenth, and the fifteenth years. If they are decanted more frequently, they lose their alcoholic strength, and their bouquet; but such wines are altogether fancy luxuries, and we ourselves have never tasted any which, in our opinion, was worth the trouble bestowed upon it. The wines of the plain of Perpignan sell, if their age is from one to six years, at from 12 to 25 francs the hectolitre; the eight years' wines fetch 50 francs; the ten years', 60 francs; and the fifteen years', 100 francs. Wine thirty years old is sometimes sold at 200 francs. Much of the wine grown here goes to North and South America, to Genoa, Cette, and Marseilles, and to a few inland places of France,—Lyons among them. Some used to go to Châlons-sur-Saône, and thence into the rest of Eastern France and Switzerland, to be used for mixing with the products of those localities. In the Canton of Perpignan there is produced a kind of rancio, called Torremila, which may be termed a true French Madeira. There are other wines which are very dark in the first years, but which at fifteen years become yellow, or straw-yellow. Of the Torremila wine a Mousseux is made.

RECAPITULATION OF THE WINES OF ROUSSILLON.

The most esteemed liqueur wines of Roussillon are the Muscat of Rivesaltes, the Maccabeo, the Grenache, and the Malvoisie.

Among the dry wines are the Rancios of Banyuls-sur-Mer, of Torremila, of Rivesaltes, and of Terrats; dry Malvoisie and Picpoule. Torremila furnishes, besides, a very celebrated white Mousseux.

Among the red or commercial liqueur wines, those which take the first rank are Banyuls-sur-Mer, Collioure, and Port-Vendres, Corneilla-de-la-Rivière, Pezilla-de-la-Rivière, Tautavel, Montner, and Banyuls-des-Aspres.

Among the dry ordinaries must be mentioned the wines of Espira-de-la-Gly, Rivesaltes, Baixas, Salces, Millas, Saint-André, and the two Cantons of Perpignan.

SHIPMENT OF THE WINES OF ROUSSILLON.

The barrels in which the Roussillon wine is made are small, and of the size of the barriques of Bordeaux. The wine is laden into ships directly from the producing district; but as the ships cannot come near to the shore in that part, the following mode is adopted for effecting the shipment of the wine:—The barrel is rolled out to the beach, and then down the beach into the water, which may be a quarter or a half an hour's distance. When it begins to float, the man who has rolled it pushes it on to the ship, which frequently he can reach only by swimming. When the cask arrives at the ship, it is lifted on board by a crane, and the man returns to the shore.

LANGUEDOC, OR THE MIDI OF FRANCE: TOPOGRAPHY AND SOIL.

Languedoc, like Roussillon, is the name of an ancient province of France, and comprises the essential parts of the departments of the Aude, of the Hérault, and of a portion of the Gard. The wines in this part are rich in colour, and distinguished by much body and spirituosity. This spirituosity is, however, exaggerated by report; for the inspectors who were sent by the Board of Customs to obtain specimens of natural wines in this district, furnished none that contained above 23·9 per cent. of proof spirit. In a great part of the Languedoc, viticulture was already in a flourishing condition at the time of the Romans, and this part still continues to uphold its ancient reputation. The wines of Languedoc are the objects of a vast commerce which is daily increasing, owing to the circumstance that no country can compete with the united advantages of climate, soil, and situation, by means of which great quantities of cheap and saleable wines are produced. The surface occupied by vineyards in the three departments mentioned, comprises 258,192 hectares, of which there are in the department of the Aude 70,982 hectares; in that of the Hérault 179,962 hectares, and in that of the Gard 75,248 hectares.

The soil is essentially the same in the whole of this viticultural district—chalky on the slopes, chalky and clayey in the plains, and silico-calcareous, and mixed with more or less rolled pebbles on the high plains or plateaux. Correspondingly, the same wines are raised throughout the whole of these departments, and the wines which are obtained from them are classified in the same manner throughout the entire province of Languedoc. They go generally under the name of *Vins du midi*, which, in the eyes of too many ignorant persons, is equivalent to cheap, bad stuff. If they knew the quantities of such wine exported to all parts of France and mixed with the Burgundies, the Bordeaux, and other varieties of French wine drunk in the country, or exported, they would moderate their dislike; and if they had the enterprise to study the wines of those countries themselves, they would see that just for the sake of their quality and cheapness they deserve to be well known in all parts of Europe, and to be at the command of every consumer. The wines are divided into two categories,—wines for the distillery, and wines of commerce. These latter are subdivided first into ordinary red and white wines of commerce; secondly, into the fine red wines; and, thirdly, into the white dry wines, and the white liqueur and Muscat wines. The sales are effected through the instrumentality of brokers (termed *courtiers*). Formerly these agents used to taste the wines, and played a great *rôle* in affairs, but now-a-days their only office is to obtain samples and bring them to the merchants. If a merchant likes a sample, he goes to the repository where the wine is lying and identifies it with the sample. Many transactions are also carried on between the producers and the merchants directly.

VINES CULTIVATED.

These are the Carignane, the Terret-noir, the Grenache, the Mourastel, the Aspiran, the Œillade, and its variety the Sinsaou, the black Picpoule, the white Picpoule, and the Clairette. These yield the wines of commerce. For the distillery wines only two are cultivated, namely, the Aramon and the Terret-bourret. These two vines cover the whole of the plains of Hérault and of St. Guilhem upon the sea, the plain of Lunel, of Orbe, and a part of that of the Aude, to the very borders of that department. The Terret-noir is recognized by long branches and closely-set nodes. Its leaves are equal in length and breadth, and show five lobes, of which the two nearest to the leaf-stalk are very deeply cut out. The bunch is pyramidal and winged, and has loosely-hanging grapes which are of equal size, oval, blackish red, transparent, and browned by the sun, so that they appear almost bluish grey. They have an acidulous taste and a thick skin.

The Terret-bourret has vigorous brown-coloured canes and middle-sized leaves, which are wider than they are long. The bunch is pyramidal, always has large wings, and bears oval grapes, of a light rosy or violet colour, and covered with brownish specks. The grapes have a flat taste, and yield only the lowest wines used for the distilleries.

The Aramon is also called the rich plant. It has a vigorous stalk, and the bays of its leaves are little marked. The bunch is exuberant, long; the grapes are round, equal, violet-black, bloomy, of a flat taste, and provided with a thick skin.

The Œillade has cinnamon-coloured canes, large leaves, and a magnificent pyramidal, winged bunch, with voluminous grapes, which hang on very long green stalks. Their colour is blackish blue. There are brown sun spots on them. Their taste is fresh, sugary, and very agreeable. They ripen early.

The Piran or Aspiran has leaves the five divisions of which are deeply cut out. The bunch is middle-sized, and bears black, greatly bloomed grapes. Their taste is fine and sugary; their skin thick. They mature early.

The white wines are mostly made of Picpoule and Clairette. It is almost impossible to say what may be the proportion of these vines in each vineyard. The vines which are planted on the alluvial flat soils are called vines of the plain. The less fructiferous soils of the alluvious district consist of rolled pebbles mixed with earth containing oxyde of iron. The vines growing there are called vines of the *terrains de grés*. They give esteemed commercial wines. The wines of the slopes (called *garrigues*) yield wines fit for exportation. They are distilled only in years of plentiful harvests. The distillery is the adjustment apparatus which keeps up the prices in abundant years. In years of dearth, on the contrary, even the wines of the plain which ordinarily go to the distillery, are bought up by merchants, mixed with good bodied wines of good years and sold to the world. These proceedings are very useful to the proprietors and merchants, but very unsatisfactory to the consumer.

The cultivation of the vine is here not very carefully performed. The vine is planted by means of blind canes, and grows easily. The soil is worked by men only in the Gard. On the gravel slopes, and in the gravelly soils, the plough is used. Wherever this is the case the feet of the vines are dressed with the hand. Manuring is vigorously kept up. In the winter a hole is dug around each vine, the manure is put in, and the earth covered over it. This extraordinary proceeding, which we have also seen practised in the Graves of the Haut Brion district, indicates great vitality of the vine. The vines in the Rhenish countries are believed not to bear such treatment, and in the Champagne the vines are also manured in such a way that the manure does not come in contact with the foot of the vine itself. The vine is generally cut in such a manner as to have four, five, or six canes which are kept upon two eyes.

Where the soil is less fertile only three branches are grown. Everywhere the vines are now cut with the *secateur* instead of with the sickle-shaped garden knife, as formerly. The vintage takes place in the middle of September, and extends sometimes into October. In the rich alluvial plains 200 hectolitres of distillery wine are sometimes obtained upon one hectare, but on the slopes and in the gravels the vines give on an average not more than twenty-five to thirty hectolitres per hectare. In certain good ordinary soils planted with fine vines, in the mixture of which there is a certain proportion of the Aramon and the Terret-bourret, fifty hectolitres per hectare are sometimes obtained.

The grapes are trodden with the feet or mashed with machines consisting of revolving cylinders. They are ordinarily powdered over with plaster of Paris, and then put into the vats. The wine is put into *foudres* or large barrels of a capacity varying from 7 to 700 hectolitres. These are filled from below by means of pressure pumps. The wine is racked in February or March, and a second time before the next vintage when it is desired to keep the wine.

DISTINGUISHED GROWTHS OF THE DEPARTMENT OF THE AUDE.

The vineyard of Limoux yields a white wine known under the name of *Blanquette de Limoux*. There is also red wine made here. 688 hectares are the extent of this vineyard. In ordinary years 10,000 hectolitres of red wine and 3,000 hectolitres of blanquette are produced. The white wine fetches double the price of the red.

REMARKABLE GROWTHS OF THE DEPARTMENT OF THE GARD.

These are three in number,—Lédenon, Langlade, and St. Gilles. These three growths are situated in the arrondissement of Nîmes. The Langlade wine is, perhaps, the best known. It is left only three days in the vat. It is light, of rich colour, and fine, and is less alcoholic than the other wines. It is grown on chalky soil, and under its name thousands of barrels of wine grown on neighbouring plantations are sold. St. Gilles has a vineyard of 5,000 hectares. Its wines have a brilliant purple colour, are soft, have much body, strength, and what the French call *nerve* and *mordant*. They are called *vins fermes*, because they can be used to give colour and strength and body to wines which do not possess those properties, and hence they are also called *vins de remède*. The St. Gilles wines bring, however, always a particular taste — so-called "taste of territory"—into the wines with which they are mixed. We believe this taste to be the consequence of bad treatment, and that if the wines of that vineyard were treated with the care bestowed upon the Roussillons and the Narbonnes, they would show nearly as much finesse as the wines of these districts. Considered in their character of dyeing agents the wines of this district are divided into six classes, and called accordingly the wines of one, three, five, or six colours, according to whether they can, on being mixed with one, three, five, or six parts of white wine, produce a well-coloured ordinary table wine. At St. Gilles wine is sold by the *barral*, which is a little more than 50 litres, and corresponds almost to the Austrian Eimer. The hectolitre may sell at 53 francs, and in good years may fall to 3 francs. The average price is 10 francs the hectolitre. Most of this wine goes to Paris and Holland.

Of the vinification in this district we ought to say a few words in particular. The care taken to extract all the colouring matter from the husks is very great. Before the vintage is mashed, it is put into closed spaces, whereby a slight fermentation begins in the unbroken berries, through which the skin is predisposed to part with its colouring matter. When this condition has been obtained the grapes are trodden with the feet, but wooden shoes are mostly worn by the workpeople, and the mash is put into the vats for fermentation. And now comes the operation which, in our opinion, gives to all wine in this district its peculiar taste. The vintagers mount to the top of the vats and submerge the hat by means of long forks, and this is repeated until the husks are deprived of the greater part or all their colouring matter.

It is clear that, in a district where the temperature at the time of fermentation is so high as in Languedoc, the upper parts of the chapeau pass into putrefaction, and, on being submerged, communicate their taste to the wine.

There are also obtained wines which, in ordinary years, remain feeble, and therefore bear an addition of spirit: these are sometimes treated as follows. The berries are put into a caldron and heated, in order to macerate the hard skins and allow the colouring matter in them to be extracted more easily. The grapes so treated are afterwards put either into spirit or into new wine. Similar means have long been adopted by the manufacturers of wines in Oporto. The fermenting-vats of the Languedoc are frequently, after twenty-four hours, deprived of a portion of their wine, which then has attained only a dark rose colour. This wine is finished in that state, and sent off to the Bourgogne to serve in what the French call the "arrangement" of the Burgundy wines. A very careful method of making white wines prevails at St. Gilles. The must, after having been drawn, is put into barrels which have before been strongly sulphured; that is to say, the oxygen contained in their interior has been absorbed by the sulphur matches which have been burned in them. The must is now allowed to run into the cask, as much sulphur being burned from time to time as will entirely absorb all oxygen. The effect of this proceeding is, that the sulphurous acid contained in the must absorbs all oxygen in the must; and as the latter is thus prevented from acting upon the albuminous matter, fermentation does not take place. The must therefore deposits all its impurities at the bottom of the cask. After two or three days it may be drawn, and is then entirely clear. Of course, very soon after fermentation begins, but it is very much slower, and leaves a great deal more sugar in the fluid than would otherwise be left. The wines of St. Gilles are most commonly used for the artificial production of Port and Sherry, of which not a little is thus made in Xeres itself. There is also produced at St. Gilles a wine called Tokay-Princess. One Dr. Beaumes manufactures this wine from the true Furmint or Tokay wine, after the manner of the Hungarian Tokay. It is sold in the place at 6 francs the bottle.

REMARKABLE GROWTHS OF THE HÉRAULT.

Among these is St. Georges D'Orques, St. Chrystol, and St. Drézéry. These three are red wines. The Picardans are white wines, and the Frontignans and the Lunels are Muscat wines. We particularly commend the wines of the arrondissement of Montpelier as being among the finest of the department. We have tasted wines from good years four or five years old, which recalled to us many of the finest qualities of Port. The Picardans wines are sweet or dry, and mostly obtained from the Clairette. The grape of this vine does not mature before the 1st of October, and it is well to let it hang for a fortnight longer before vintaging it. The wines obtained from it have much similarity to Madeira, and they contain from 13 to 15·5 per cent. of absolute alcohol. They are frequently mixed with alcohol. If they are not dry enough they are exposed to the sunshine in large barrels for some months, the manufacturers thus imitating the practice of

FIG. 62.—Vine of the Hérault, with all its wood, as seen in winter.

the Spaniards, who also mature their wines in the sunshine, while in Madeira they lay them in hot chambers specially constructed.

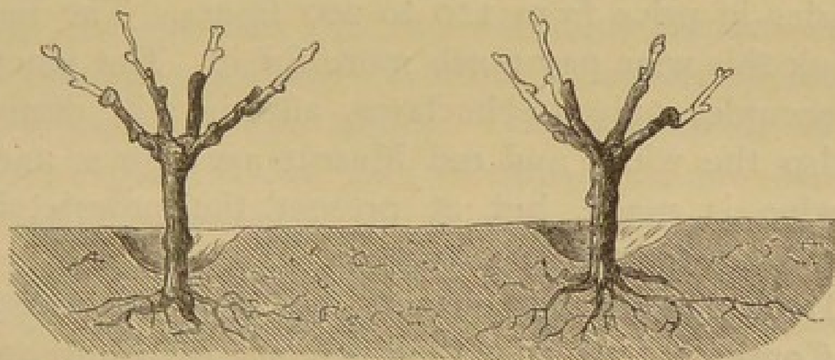


FIG 63—Vines of the Hérault pruned and their "feet" uncovered.

The hectolitre of Picardans wine is ordinarily sold at from 12 to 16 francs. Sweet wines are here made by sulphuring

FIG. 64.—Vine of the Hérault and Lot in full bearing.

the must and allowing subsequent fermentation, which, if the wine is not very syrupy, is interrupted by the addition of spirit. Most of these wines are now used for imitating Spanish wines, such as Alicantes, Sherries, and Malagas.

MUSCAT WINES.

These wines are made from Muscat grapes—mostly white,—more rarely black ones. The grapes are exposed to the heat of the sun until they are half transformed into raisins. They are then mashed and the juice is expressed. The most notable of them are made in the vineyards of Frontignan, on about 230 hectares, from the two varieties called the white Muscat and the red Muscat. There are annually produced about eight or nine hundred barrels, containing from 220 to 225 litres each. Of red Muscat there are only 20 hectolitres produced. This latter wine somewhat resembles the Cape Constantia wine. The barrel of Muscat wine varies in price from 120 to 200 francs. The bourgeois who drink this wine pay much more for it. The vineyard of Lunel occupies only 50 hectares, and is still diminishing. Here also the white and red Muscat are grown, and much sweet wine is made, but at present the proprietors turn towards the making of other wines.

The Lunel Muscat was formerly celebrated in many parts of the Continent, but since the discovery of the resemblance to Muscat of the flavour of tincture of elder flower a drink can be made by its aid from alcohol, sugar, and a little tartaric acid, which in many cases is superior in flavour, and certainly in purity, to true Muscat of Lunel. In consequence of this the Muscat has lost its standing. There are yet Muscat wines of Maraussan and Espagnac. Their production and nature are similar to those of the previous ones.

MANUFACTURE OF TROIS-SIX AND EAU-DE-VIE AT MONTPELIER.

In the department of the Hérault two qualities of trois-six are made—one of wine and another of murk. The former ones are called "of good taste" (*de bon goût*) when the wine from which they have been made was neither spoiled nor sour. The second sort are always called trois-six of murk, and are in general from 25 to 50 per cent. less valuable than the others. The trois-six of good taste occupy the most important position, both as regards quality and quantity. They are obtained by means of a still which from its inventor is called De Rosne's. This apparatus is made at Mèze, Lunel, Montpelier, and Béziers; it costs from 2,000 to 4,000 francs, and yields in twenty-four hours of distillation from two to four pieces of alcohol of 86 per cent. strength, each piece being six hectolitres. Two men, the distiller and an assistant, are sufficient to conduct the working of an apparatus. The distiller regulates the fire, the level of the wine in the columns of condensation and of distillation, and also the evacuation of the residues. The assistant feeds the reservoirs containing the wine, rolls the pieces to the pump, and occupies himself with the other accessory detail. When the apparatus is kept in action day and night, two distillers and two assistants become necessary for the twenty-four hours. A distiller receives three francs a day,—his assistant, two francs. The production of three-six is very regular in this kind of apparatus, and depends, of course, upon the strength of the wine employed. The wines of the plain contain from 7 to 11 volumes per cent. of three-six of 84°. It is therefore clear that an apparatus which can produce four pieces per day, and consume 336 hectolitres of feeble wine of the plain, containing 7 per cent., will, when consuming wines containing more alcohol, say 14 per cent., only consume half the quantity; that is, 168 hectolitres of wine. The average strength of the wines distilled is 11 and 12 per cent. of three-six when the year is good, so that one can assume that a manufactory which produces four pieces of three-six in twenty-four hours, consumes from 230 to 240 hectolitres per day. Such a manufactory, therefore, discharges every day more than 200 hectolitres of residue. These residues have a repulsive odour, and being let into the rivers and watercourses, or canals, infect the air more than sewage. Hitherto no use has been made of them either on account of their tartaric acid or their potash.

The price of the wine used for distilling is dependent upon the quantity of alcohol which it contains. It is generally ascertained by means of small assay stills, and the specific gravity of the distillate is measured by a centesimal areometer. Proprietor and manufacturer each determine the quantity of alcohol contained in the wine to be sold, and afterwards they discuss the price to be paid. A manufactory which is in good condition and well constructed, can make a hundred pieces without being cleaned; but it is considered well to clean the apparatus at the slightest sign of impurity, for when it becomes dirty, it produces much less spirit in the same time while burning the same amount of fuel. Moreover, in the dirt there is lost much wine or alcohol. A loss of alcohol is experienced also when the apparatus is not well closed. The strength of the spirit which has been distilled is always ascertained with the aid of the alcoholometer of Bories. This is a very ancient instrument, and manufacturers and producers of the Languedoc are as reluctant to give it up as the Germans are with regard to that of Tralles, or the English with regard to that of Sikes. The piece of three-six, accompanied by a warranty of its quality, is taken to the market. The inspector of the market verifies the analysis, and if correct admits, if incorrect, returns the piece. The inspector states the limpidity, which must be perfect; he observes the colour, of which there must not be any; the taste, which must be pure and free. The accepted piece remains in the hands of him to whom it is sent. The piece which was not in perfect condition is kept until a reduction in the price may have caused it to be accepted. If the piece were of very bad quality it would be judged, and pronounced *mauvais goût*, and in that case would be paid for only as three-six of murk. There are in the department of the Hérault four markets for *eau-de-vie* and alcohol. They are in the order of their importance, Béziers (on Friday), Pézenas (on Saturday), Cette (on Wednesday), and Lunel (on Monday). If there are no stipulations made to the contrary, the manufacturers of three-six are bound to deliver all produce to one or other of these markets. All three-six is paid for in cash. One day in every week is assigned in each of the markets for the assembly of the merchants, manufacturers, and brokers. The three-six is received by the inspector every day except Sunday, and each market has its special inspector. The salary of the inspector consists in an impost of half-a-franc upon each piece.

The apparatus of De Rosne which we have mentioned can be used to make alcohol called Trois-cinq = 3/5, and another kind called Proof of Holland. The strength of the 3/5 is 78° centesimal; that of the Proof of Holland is 58.[1] This being by volume is about equal to the English proof spirit. These liquids are put in barrels, transported, and delivered just in the same manner as the 3/6, and their current price depends upon that of the 3/6. The 3/5 or the 3/6 are employed to strengthen wines—as the French say, *viner les vins*—which have not got enough body and require to be exported. The Holland Proof serves for the same purpose. They are also used for making the better class of *eau-de-vie* of Montpelier. The first qualities are made with white

[1] Rendu, "Vins du Languedoc," i. 71, gives Proof of Holland as 52 vol. per cent. Payen, "Chimie Industrielle," 3rd edition, p. 712, gives Proof of Holland at 58·7 and Proof of London at 58 vol. per cent. British (or Sikes's) proof spirit at 15°5 contains 57·06 vol. per cent., or 49·24 weight per cent. of absolute alcohol. The several designations of spirits of various strengths used in the Languedoc and other parts of France are derived as follows:—Common *eau-de-vie* is accepted as the standard, and supposed to show 19° Cartier at 12°5 temperature. It then contains a little less than 50 vol. per cent. of absolute alcohol. Trois-six is a spirit, of which three volumes added to three volumes of water were supposed to give six volumes of *eau-de-vie* of 19° Cartier. It is the common alcohol of commerce, marks 33° on the scale of Cartier, and contains, consequently, 84·4 vol. per cent. of absolute alcohol. Trois-cinq is a spirit, of which three volumes added to two volumes of water were supposed to give five volumes of *eau-de-vie* at 19° Cartier, while trois-sept is an alcohol of which three volumes added to four volumes of water were supposed to give seven volumes of standard *eau-de-vie*. It is evident that by the introduction of the mathematical methods of ascertaining the strength of spirits these names have lost their meaning, the very standard of *eau-de-vie*, with 50 vol. per cent. of alcohol, excluding the possibility of the existence of an alcohol called trois-sept. But whenever these names are used without the definition of the exact strength in volume per cent., or degrees Cartier, we may assume that by 3/7 is meant a spirit of 94 per cent. vol., by 3/6 a spirit of about 84 per cent. vol., by 3/5 a spirit of about 78 per cent. vol., by the several proof *eaux-de-vie* the strengths above given, by *eau-de-vie* double de Cognac a spirit of 52·5 per cent. vol., by *eau-de-vie* as commonly sold in retail a spirit of 49·1 per cent. vol., and by common feeble *eau-de-vie* a spirit of 45·5 per cent. vol.

wines just fermented, which have not been fermented with the stalk. Generally the good quality of Terret Bourret is used for making this wine. Sometimes manufacturers who desire to make very good *eau-de-vie*, take wine made from Picpoule. The new red wines, provided they have not been allowed to ferment in the vat with the stalk, give also excellent *eau-de-vie* of great softness. The *eau-de-vie* of Montpelier is made with the same apparatus as that which produces the 3/6, but it is arranged a little differently, so as to give a lesser strength. The *eau-de-vie* of Montpelier, however, is almost a thing of the past. Commerce and manufacture have given it up, and devoted themselves almost exclusively to the strongest kind of alcohol that can be produced by mere distillation. The average production of trois-six is enormous. While no more than 2,000 pieces of *eau-de-vie* are annually produced — 6,000 hectolitres of 52° — the manufacture of 3/6 rises to 60,000 pieces, equal to 360,000 hectolitres of *eau-de-vie*. The arrondissement of Béziers yields regularly two-thirds of this quantity, and sometimes three-fourths. 60,000 hectares of vineyards of the Hérault produce nothing but wine to be used for distilling. The average production of 3/6 in the four departments—the Eastern Pyrénées, the Hérault, the Gard, and the Aude—has been 500,000 hectolitres. The 3/6 of wine are made by manufacturers who make a distinct occupation of it, or by proprietors who have a still attached to their farm arrangements. These farm distillers are more numerous in the circle of Béziers than in that of Montpelier. The larger quantity of the wines is distilled by the professional manufacturers. They have their manufactories in the villages, in the very centre of the great production, and they concentrate in their hands all the disposable wine after each vintage. The manufacturing time begins with the first days of October, and continues longer or shorter, according to the abundance of the harvest—sometimes for three months, sometimes for six. The first trois-six, which are distilled from the new wines, are always the best. The 3/6 of murk is obtained by subjecting the murk as it comes from the press—of course after fermentation—to the heat of water or steam. For this purpose there are attached to the apparatus De Rosne two large cylindrical copper vessels, into which the murk is put. Into these a current of steam is now directed, which carries the spirit away. One vessel is charged while the other is working, and *vice versâ*, so that the distillation continues without interruption. With an apparatus of the power of four pieces, one piece of 3/6 of murk can be made in twenty-four hours. The richness of the murk in alcohol varies with the degree of desiccation and the strength of the wine which it has produced. There is no means at present for determining the amount of alcohol in murk. The manufacturers buy the murk at a fixed price, so that they are assured of having a sufficient quantity for keeping their machine going when it is once arranged. When the trois-six of good taste are rare or very dear, the murk is washed methodically with water. The water then takes up the wine contained in it, and this more or less alcoholic water is now distilled. This yields a spirit of good taste, while if the murk itself were distilled it would have the peculiar bad taste of murk spirit. This bad taste of the murk is particularly developed when it has been kept for some time, and is, of course, a product of the putrefaction of its albuminous ingredients. It is calculated that on an average 130 muits of murk are necessary to make a piece of 600 litres of 3/6. The muit of murk weighs on an average 100 kilogrammes. 13,000 kilogrammes of murk therefore yield 600 litres of spirit. In the canton of Lunel many proprietors fatten sheep by means of the murk of grapes, from which in the morning they distil, by means of special apparatus, the alcohol previous to feeding. The animals thus get the murk cooked and warm. The alcohol is produced gradually, and is taken to the market when the barrel is filled. The murk which has been used by the manufacturers who have no live-stock is used as manure.

The *eau-de-vie*, the trois-six, and other alcohols of the Hérault, are mostly sold in France, but a great proportion is exported to foreign countries.

CHAPTER XII.

WINES OF THE EAST OF FRANCE.

WINES OF THE RHÔNE VALLEY :—Topographical survey.—Côte-du-Rhône.—Classification of its wines.—Château-neuf-du-Pape.—Vineyard of St. Péray (Ardèche).—Vineyard of the Ermitage.—Vineyards of Crozes, Larnage, and Mercurol.—Vineyards of La Rolière and Die.—Vineyard of Condrieu (Department of the Rhône).—Vineyard of Côte-Rôtie (Department of the Rhône). WINES OF THE SAÔNE VALLEY :—General survey of the district.—The Beaujolais.—Topography.—Dominating vines and their cultivation.—Vintage.—General classification of the vines.—Special classification of the wines of the Beaujolais by traders of Mâcon.—The Mâconnais.—General division of district and soil.—Predominating vines.—Mode of cultivation.—Vintage and treatment of red wine.—Cultivation of the white vine.—Maturing and character of white wine.—Classification of Mâconnais wines by the merchants of Mâcon.—Côte of Chalon.—Topography and vines.—Wine.—Remarks on Giboudot.—Quantity.

TOPOGRAPHICAL SURVEY.

THE greater and most reputed part of these wines is produced on the *right* bank of the Rhône, in the communes of Laudun, Chusclan, Tavel, Roquemaure, which belong to the department of the Gard ; in the district which is represented by the name of St. Péray, department of the Ardèche ; and at Condrieu and Côte-rôtie, department of the Rhône. A much smaller quantity of wine is grown on the *left* bank of the Rhône, but this includes the products of Château-neuf-du-Pape, department Vaucluse, and of L'Ermitage, department of the Drôme. The vineyards of Croyes, Larnage, and Mercurol, in the same department, produce wine which, in quality, follows immediately after Ermitage. Of these wines those grown in the Gard have the general character of the wines of the Midi, as described in the chapter on Languedoc. The white St. Péray has a character of its own, particularly in the effervescent state. The wines of the upper part of the Rhône, Côte-rôtie, resemble those of the Beaujolais and the Côte-d'Or. The wines of L'Ermitage are distinguished by peculiar qualities, and a pleasing bouquet, coupled with great finesse; and those of Château-neuf-du-Pape owe their trade-value and export to Burgundy to their spirituosity and colour.

The greater, particularly the lower, part of the wine-growing region of the Rhône valley, has a calcareous soil, which, on the left bank, is mixed with clay and pebbles. The upper parts of the borders of the Rhône are formed of granite, which, in the less inclined situations, is mixed with alluvium.

CÔTE DU RHÔNE.

The vineyards in the Gard are properly so called. They are about 30 English miles long, by six wide; the cultivation of the vine is the same as at St. Gilles. Many of the wines are, however, either not vatted at all, or only for a short time, so that they are but moderately coloured. The black grapes grown there are the Terret, Picpoule, Piran, Camanèze, and Grenache, or Alicante. The latter is the basis of the good qualities of the wines of these regions. In some localities the Uni and the Bourboulenque are grown on a small scale with the others. Of the white grapes the Clairette and Calitor form about a fifth part; the others are Uni blanc, Picardan, and several unimportant varieties. The wines of this region are classified in the order of their merit, as follows:—

FIRST CLASS. *Red wines, not vatted.* *Tavel.*—Very dry, very light-coloured wine; improves much by age. Annual produce 3,000 pieces of 280 litres measure, and about 50 francs value each.

Lirac.—Very dry wine, more firm than Tavel, of a lively rose-colour. Annual produce 1,000 pieces of 50 francs value each.

Chusclan.—Very agreeable liqueur wine. Produce 2,000 pieces per annum, value 50 francs each.

SECOND CLASS. *Red wines, not vatted. Orsan.*—A tender wine, of deep colour. Annual produce 1,500 pieces, of the value of 45 francs each.

St.-Geniès-de-Comolas.—This wine has analogy with Chusclan. Produce 3,000 pieces per annum, of 45 francs average value.

THIRD CLASS. *Saint-Laurent-des-Arbres.*—Wine of half a colour, so called, 3,000 pieces, 45 francs.

Roquemaure.—Its better qualities are of good quality, and valued as dinner-wines. 5,000 pieces, 45 francs.

WHITE WINE. *Laudun.*—White agreeable wine. 1,000 pieces, 50 francs. 700 pieces are dry wine, while 300 pieces are converted into sweet wine.

CHÂTEAU-NEUF-DU-PAPE.

This vineyard, of about 600 hectares, is situated on the left bank of the Rhône, a few kilomètres from Orange. The properties are mostly inclined towards the South; some, however, are in the plain, and have contributed most to destroy the reputation of this vineyard. The black grapes cultivated here are the Grenache, Picpoule, Tinto, and Terret noir; of white varieties, the Clairette, Uni, and Muscat. The cultivators say that the Grenache gives alcohol and finesse, the Picpoule generosity, the Tinto colour, and the Terret quantity. The vines are never manured, but here and there they get a little earth now and then. The vines are trained with from three to five branches, of which each carries an element. The latter has only two or three eyes. The vines begin to bear in from three to five years after planting, and continue to bear for twenty years. The best vines, the Grenaches, are the latest to bear, and the earliest to decay. The vintage takes place in the latter part of October. The average harvest amounts to 20 hectolitres per hectare; but well-kept *grenachières* (as vineyards planted purely with grenache are called), in a good soil, produce up to 30 hectolitres per hectare. As a general rule the stalks are taken off the grapes already in the vineyards, and left there. The grapes are crushed in mills, and dropped into the vats, where they remain fermenting and macerating for from fifteen to eighteen days, and sometimes longer. At last the wine is drawn into barrels of 270 litres each; these are not bunged, but covered with a piece of tile until the new year, when the bungs are put in. The wine is sold at the vat, at prices varying between 25 and 50 francs, the piece of 270 litres. It does not keep in barrel longer than three years, after which, if its colour is to be preserved at all, it must be bottled. The most remarkable vineyards of this district are the following:—

Vineyard of La Nerthe.—This vineyard gained its reputation through the owner, the Marquis of Villefranche, who frequently treated his guests at Paris to old fine Nerthe. The product is not now husbanded to the same advantage, and has lost in value, the high age of many of the vines notwithstanding. The varieties are Picpoule, Clairette, Terret noir, and Picardan. New plantations are made in Grenache to the extent of two-thirds. Value 240 francs the piece, of 270 litres, *loco.*

The *Cru de Condorcet* is situated below the Nerthe, and measures 20 hectares; 40 francs per hectolitre; price increasing, on account of planting of Ermitage and Sirrah vines.

Vineyard of Fortia occupies a place similar to that of the Nerthe. The wine is stronger, but also coarser than that of the Nerthe. Under the old proprietor, the Marquis de Fortia d'Urban, the average product was 30 pieces per year, but it has risen to 100 now.

The Vineyard of Vaudieu produces light-coloured and less alcoholic wines. Several parts of it are planted exclusively with white vines, such as Clairette, Uni, Pascal blanc, Bourboulenque, Muscat. From these a dry wine is made, in the ordinary manner; also a sweet wine by the addition of spirit to the must. The dry wine has some similarity with Spanish wine. Price not below 80 francs per hectolitre.

In the commune of Château-neuf-du-Pape, the land is extremely subdivided, every owner is a vinegrower, and his harvest 12 to 35 pieces a year. The wines are mostly bought after the harvest by the commission agents of Roquemaure.

These now mix and otherwise belabour them, and send the greater quantity of them into Burgundy, to be used there as "the doctors" to feeble, acid, and pale wines of bad years. Bordeaux also receives a quantity of these wines for the same purpose. In consequence the wines of Château-neuf-du-Pape do not occur in trade in their original condition at all; when bought for mixing, they are already in a mixed state. The proprietors work up to the trade demand, and plant vines so as to produce an alcoholic black wine. They also want to produce greater quantity and plant vines in the plains. By these proceedings the grounds for the ancient reputation of this vineyard are rapidly disappearing.

The department of Vaucluse has yet several small vineyards of quality, of which that of Château-vieux cultivates peculiar vines, the Mollard, the Mollardon or petit Mollard, the plant du Four, and the Espagnis or Pis de Chèvre. This latter is distinguished by its berries, which are like olives; they are always sweet, even when not quite ripe.

(VINEYARD OF SAINT PÉRAY ARDÈCHE).

In ascending the Rhône, the next vineyard which the traveller meets with is that of St. Péray, situated on the right bank of the river, in the department of Ardèche. It is 172 hectares in extent, all situated upon slopes, facing the east. The soil is gravelly clay with iron; the wines produced are all white. The dominant vine is the *Grosse Roussette* (Roussanne of the Ermitage); it is mixed with a small proportion of the petite Roussette, but with no other vine. Plantation and cultivation of the vine offer no peculiarities. The dry wine is made in the ordinary manner, and the effervescent St. Péray is produced in the same manner as effervescent Champagne. Still St. Péray is put into bottles only in the third or fourth year. The most celebrated growths of St. Péray are Côteau-Gaillard, Solignacs, Thioulet, and Hongrie; after these range Savoie-les-Sapettes and Malayon. The best wine has a value of 75 francs the hectolitre, the second quality 50 francs. Grand mousseux of the best years is sold at from 2 francs to 2 frs. 50 c. the bottle retail; while still wine, five or six years old, has the same value. The mousseux is very heady, and neither so fine nor so mild as Champagne.

In the same department of the Ardèche there is the vineyard of St. Jean, which produces white wines equal to third class St. Péray. Red wines are grown at Cornas and St. Joseph. The vines are Picpoule and Sirrah. Quantity per annum 2,000 pieces of two hectolitres each, selling at 80 to 120 frs. They resemble in body the third-class Ermitage, but have no bouquet whatever.

VINEYARD OF THE ERMITAGE.

The good growths of the Ardèches end at Tournon, and opposite this place, on the left border of the Rhône, begin the vineyards of the Ermitage. They are situated in the commune of Tain, 28 kilomètres from Valence, department of Drôme, have a surface of 190 hectares, and are distributed over two slopes. One of these is on granitic soil, the other on alluvial. They are exposed to the south-west, in such a manner that the sun strikes them from his rising to his setting. Their highest point is 160 metres above the level of the Rhône. The name is derived from a place of retirement, which one Gaspard de Sterimberg, a courtier of Queen Blanche of Castile, built thereabouts for his old days in the year 1225. The vineyards are naturally of three kinds, according to the soil: granitic, constituting the so-called "Mas des Bessas;" alluvial, forming the "Mas du Méal;" and alluvial clayey, forming the "Mas de Greffieux." The high quality of the Ermitage wines depends upon the combination of these three vineyards, the produce of which is always sold *mixed;* and a proprietor, in order to have his produce classified "premier cru," must hold property in the three vineyards. The wines of Bessas are not so fine and well-flavoured as those of Méal and Greffieux, but they have a very deep colour. What is called Hermitage, and has any quality, is always a mixture of the three "Mas." The wines grown in this district are the "grosse Sirrah" and "petite Sirrah" for red wine; and the "Roussanne" and "Marsanne" for white: the "grosse Sirrah" is remarkable for its fertility, but produces a common wine; it is therefore gradually driven out of the good vineyards, and is grown in the plain. Nineteen out of twenty parts of the hill district cultivate the "petite Sirrah;" the rest is planted with white vines. The "petite Sirrah" has canes of a dark cinnamon colour, with long internodes. The leaves are great, thin, very variable, ordinarily divided in five lobes, light green, and downy on their lower surface. The bunch is fine, elongated, winged, bearing slightly oval grapes, which are unequal, closely packed together, of a blackish violet colour, much browned on the surface, juicy, very sweet, and have a thin husk. They ripen early. The grapes of the Roussanne are white, small, round, unequal, and very much browned under a thick bloom; the bunch of the Marsanne is not so long as that of the Roussanne; its berries are unequal and very closely set. The vines are trained upon two elements each; the elements do not get more than three eyes, and are kept as near to the ground as possible. In consequence of this, many of the bunches of grapes lie partially on the ground when nearly ripe, and become covered with earth. This entails a special operation in August, called "unearthing the grapes." The vintage ordinarily takes place in the second half of September. But in early years the villagers hasten to have the harvest in before the equinox, as heavy rains are not rarely experienced at that time. A hectare brings about 24 hectolitres of wine. Its purchase value is 60,000 francs in the first growths, 48,000 in the second, and 36,000 in situations of the third order. The cultivation costs about 900 francs per annum. Nine-tenths of the wines are red, the rest is white wine, among which there is some straw wine. To make one barrique of 210 litres of this latter requires 760 kilogrammes of grapes, which without drying would have yielded three barriques of wine. The black grapes are unstalked, crushed or trodden, and fermented in vats. The contents of the vats are then stirred twice a day for a week, and ultimately once a day. This goes on for about a month, and what is curious, the longer the better are the crus; in one of the best vineyards the "cuvage" lasts as long as forty days. This seems required by the large amount of sugar contained in the must, of which the last portions are only slowly transformed in the strongly alcoholic liquid. The fermented wine is put into barrels and racked once a year. It is ripe for bottling after four years. White wine is made here as elsewhere, and is ready for bottling after five years. It ripens after one year, and keeps indefinitely. The best red Ermitage is sold at about 400 francs the barrique of 210 litres. Straw wine, which requires seven years for maturing, is sold at 7 to 8 francs the bottle. It is a mere curiosity. Red Ermitage goes to Bordeaux, to be mixed with the colder growths of the Gironde; its first qualities are never sold in trade as such, just because of the value which they possess for adulterating Bordeaux wines. Anything sold in trade as Ermitage is always second class, if it is Ermitage at all. When genuine it is distinguished by great richness, a lively purple colour, and a special bouquet, and becomes by these united qualities the best wine of the south of France.

VINEYARDS OF CROZES, LARNAGE, AND MERCUROL.

Their products take the rank next to Ermitage. Crozes has 120 hectares, and its red wines fetch from 40 to 50 francs per hectolitre; its best qualities in good years, 100 to 150 francs. Mercurol produces red wine, value 30 francs per hectolitre, on 170 hectares; vines and vinification as in the Ermitage. The small vineyard of Rochegude is near to the foregoing.

VINEYARDS OF LA ROLIÈRE AND DIE.

La Rolière grows white wine on 7 hectares planted with grosse and petite Sirrah, Roussanne and Marsanne. The wine is a sweet, syrupy drink, of which the fermentation is suppressed by frequent sulphuring and by filtration and racking of the must repeated every five days. In the neighbourhood of Die a white mousseux, termed "Clairette de Die," is made from the grapes of a peculiar vine termed the "Blanquette." The grapes are unstalked, crushed, and pressed; the juice is put into barrels and racked after twenty-four hours. It is then racked every two or three days during about two months, and when it has ceased to ferment is fined. The clarified wine is put into bottles in the following March, and then becomes effervescent. But it loses this quality after two years; and if it is desired to keep it permanently effervescent, it must be treated like Champagne. The latter process is but rarely adopted. The "Clairette de Die" is sold at one franc the bottle in the Lyonnais, Dauphiné, and Provence.

VINEYARD OF CONDRIEU (*Department of the Rhône*).

Under the name of white wines of Condrieu are comprised the wines grown in that locality and also those of St. Michel in the department of the Loire. They are all produced on the same slopes, and from the same vines, the "Vionnier," and the "Terine noire." Each vine is trained with one element, which bears a fruit cane with from ten to twelve eyes, and a shorter wood cane. Principal growths at Condrieu: Lot and Chéry, surface 35 hectares, of which 22 are first, 13 second class. Principal growths at St. Michel: Château Grillé, surface 45 hectares, of which 25 are first, 20 second class. The wine of these districts is a kind of imperfect mousseux. The grapes are pressed, the juice is put into barrels, and is then racked every twenty-four hours during a week to get rid of yeast particles. In winter it is fined, and in March it is bottled. It now begins to ferment, and the bottles are therefore allowed to stand upright as beer bottles are with us, to admit of the escape of the excess of carbonic acid. If the bottles were laid horizontally, many would break. The wine is thus an imperfect Champagne, as it is not disgorged and consequently not clear, or at all events each bottle contains a turbid part like a bottle of ale.

It can be drunk six months after having been made. The hectolitre of non-manufactured dry white wine is sold at 40 francs.

VINEYARD OF CÔTE-RÔTIE (*Department of the Rhône*).

This vineyard is situated in the commune of Ampuis, a few kilomètres distant from Condrieu, and has a surface of 38 hectares, of which 26 are first, 12 second class. The slopes are inclined towards the south-west. The vineyard is divided into five parts by the two principal growths, Côte-Brune and Côte-Blonde. In the Côte-Brune the Terine noire is more preva-

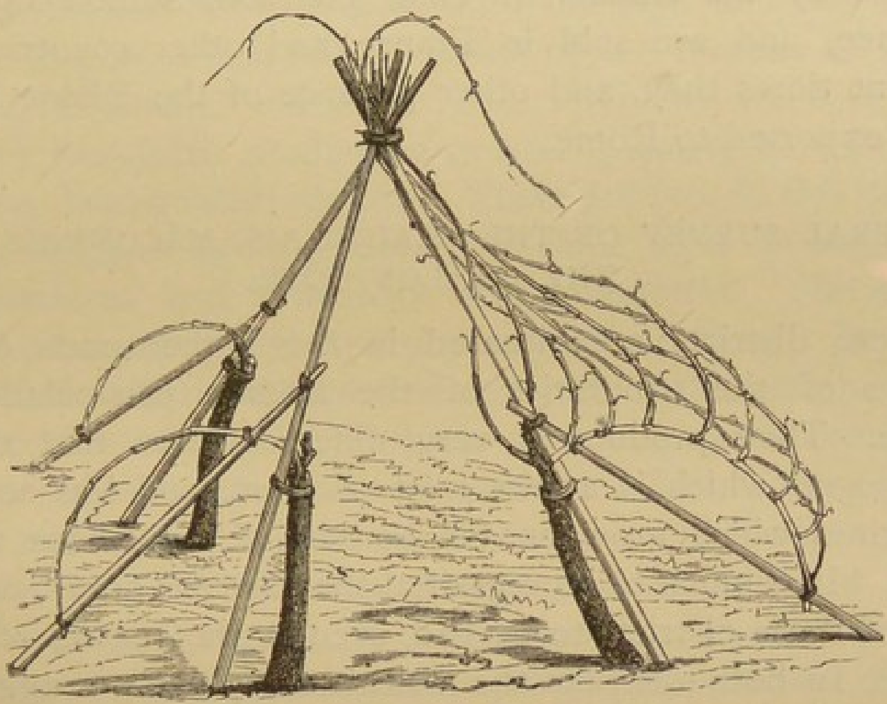


FIG. 65.—Group of vines as trained on the Côte-Rôtie. On the right a vine with all its autumn wood: on the left two vines pruned so as to have a fruit-branch, bent in a long arc downwards and tied to a stake, and a short wood-branch.

lent, while the Côte-Blonde has more Vionniers. The first growths of the Côte-Rôtie are the Brune, the Blonde, Turque, Grande-Vigne, Grosse-Roche, Grande-Plantée, Claperanne, and Poyette. The second growths are the Moutonnes, Journarys, Crêt, L'Enceman, Mollard, and the haut du côteau de Fonjean. The wines here made are all *red*. The grapes are rudely thrown into vats, and neither unstalked nor much crushed; the vats are covered with pierced lids, and left for eight days, until fermentation is completed. The made wine is racked twice a year, and ullage filled up in March and September. At six years it is ripe for bottling, and becomes fit for drinking after the first or second year in bottle. The piece of Ampuis, measuring 240 litres, is sold at about 200 francs. The wine is fiery and heady, but has great finesse and much bouquet. When made from the Vionnier mainly, it is lighter and more delicate, and does not lose its colour by age, but when made principally from the Terine the wine is more harsh and of darker colour; in bottle it forms a strong crust, and loses its purple colour, and becomes of the light red colour of onion peel. The wines of the Côte-Rôtie are bought by the traders of Tain, Tournon, Saint-Péray, and Valence, and are sold in France and other countries. In ancient times they, and other produce of the Rhône valley, were exported to Rome.

GENERAL SURVEY OF THE BEAUJOLAIS, MÂCONNAIS, AND THE CHALON CÔTE.

These districts are situated in the higher parts of the valleys of the tributaries of the Rhône, particularly the Saône. Their produce is very different from that of the Bourgogne, which is at the west of them, and less so from the wines which grow on the borders of the Rhône to the south. It is much to be regretted that there is no viticultural map of those districts to be had, even in the centres of their trade. In both districts the viticultural parts are agglomerated, partly on slopes running towards the Saône, partly on rich flat land, which everywhere else would be cultivated for wheat. This agglomeration is evident to the traveller through either district, for whether he travels by rail or carriage, he enters suddenly upon a viticultural district, continues in it, perceiving right and left nothing but vines, and after having travelled some miles he suddenly leaves it, whereupon all viticulture ceases, and nothing but ordinary agriculture becomes visible. In France the Beaujolais wines are more commonly sold under the name of Mâconnais; but in England the very reverse obtains, and "Beaujolais" is a more charming name to the merchant and consumer than "Mâconnais." In our classification of these wines we shall show that there are amongst them some, but very few, qualities of the first rank. Such are the Moulin-à-vent and the Chénas. The rest are good ordinaries.

THE BEAUJOLAIS.

The Beaujolais was formerly a county, and a part of the government of Lyons. It is now an arrondissement, of which Villefranche is the principal place. It extends from the confines of the Mâconnais to the district of Lyons. There is a chain of mountains in this district traversed by numerous valleys, and the conformation thus engendered produces a natural division of the district into the *high* and *low* Beaujolais. The *high Beaujolais* consists of the cantons of Beaujeu and Belleville, where the best vineyards are met with. The low Beaujolais produces a greater quantity of wine, but of a less distinguished quality. There are now in this district 20,000 hectares of vineyards stretching over a length of 35 kilomètres, and a breadth of 6 kilomètres. The soil is granitic, the red quartzy porphyry predominating. In other parts of the district a schistose soil comes out, and between these two extremes of Plutonic and Neptunic formations there are many gradations and mixtures. There is some very clayey soil. In the lower parts of the valley the soil becomes alluvial. Here also chalk appears, which in the Haut-Beaujolais is never present. In these clayey and chalky soils the wine loses much of the quality which it possesses in the higher situations. The exposure of the principal vineyards of the Beaujolais is towards the east and the south. Some are turned towards the west. Their inclination is very varying, and is different with every growth.

DOMINATING VINES, AND THEIR CULTIVATION.

There are two vines which prevail in the Beaujolais; namely, the Petit Gamay and the Gamay Nicolas. The latter has very short-noded canes, and small leaves, which are as wide as they are long, five-lobed, and of a light green colour. Its flowers perish easily in bad weather. The grapes are elongated, conical, and winged. They are loose-hanging grapes, unequal, of middle size, ovoid, black, very bloomy, juicy, with a thin skin, and of a particularly sweet taste. This vine is the basis of all the better growths. In some parts, on the borders of the Saône particularly, other varieties of the Gamay are met with, as also the Persagne. This latter variety is more productive, but gives a wine of an inferior quality. Viticulture is here carried on by resident vineyard men, each of whom gets an area of from four to five acres as a farmer from the proprietor, and cultivates it with his family. The rent which he pays is half the produce in wine. The plantation is that which is usual everywhere; namely, with blind canes. The vineyard is dug round three times,

FIG. 66.—Vine of the Beaujolais fixed to its stake, in full bearing. On the right a pruned vine of the Beaujolais before the commencement of growth in spring.

or turned with the hoe, all the work being done by hand. The vine is dressed upon what is called three or four horns, and of these horns each gets two eyes. At Fleury the old vines are allowed only one eye on each horn, but the young ones are allowed three. The vines are not everywhere supported by stakes, but are trained up so as to stand by themselves as low shrubs. Sometimes they are allowed stakes for six or ten years, until they are strong enough, and then the stakes are taken away. The renewal of vines by layers is not at all usual. This arises, no doubt, from the particular mode of cutting which produces one or more heads on the top of a vine-plant, which is a foot or eighteen inches high, and then produces a great number of shoots, but no good canes which could be laid down. In some parts of the Beaujolais we have also perceived the new method of training vines on wires stretched in parallel rows across the field, and fastened at each end to posts of stone. After the vine has attained a certain age, it does not remain fructiferous. It is then torn out, the soil re-grubbed, and a new plantation effected. The productiveness of the vineyards is here enormous, a hectare yielding in the Haut-Beaujolais on an average twenty pieces of 210 litres each. In the Lower Beaujolais this quantity is yet far exceeded.

VINTAGE.

The vintage takes place from the 20th to the 30th of September. The stalks are not removed from the grapes, and ordinarily the grapes are not even crushed. The vintage is thrown into vats, and then allowed to ferment for eighteen, twenty-four, or forty-eight hours. In cold autumns the vatting has to be continued for six days. The wine is then treated like that of the Bourgogne.

GENERAL CLASSIFICATION OF THE WINES.

The better wines in the Beaujolais may be arranged under three categories:—First, the fine, early maturing, and little-coloured wines of Chénas, Fleury, Lancié, St. Etienne-la-Varennes; secondly, the fine, strong, deep-coloured, and long-lasting wines, of which Julliénas is the representative; and, thirdly, the semi-fine wines which are esteemed, but do not reach the quality of the former. The wines in this district are more delicate than the wines of the south of France. They taste juicy, and frequently are very sour. It is for this reason that they are esteemed in France, where it is usual to mix water with the wine. To countries where this process is not usual, only the good wines with a minimum of acidity can be imported.

CLASSIFICATION OF THE BEAUJOLAIS WINES BY THE TRADERS OF MÂCON.

ARRONDISSEMENT OF VILLEFRANCHE.

Charentay, near Belleville.
La Chassugne, near Ansi.
Tullié, near Beaujeu.
Lancié, near Belleville.
Lantigni, near Beaujeu.
Opunicié, near Beaujeu.
Regnié, near Beaujeu.
Villié, near Romanèche.
St. Lager, near Belleville.

These wines are not generally known in commerce (except in their own district) under these names. They are included generally under the name of Beaujolais Ordinaire, Beaujolais Grand Ordinaire, according to quality. These wines are sold, according to quality, from 80 francs to 110 francs for the 1866, and from 115 francs to 140 francs for the 1865.

ARRONDISSEMENT OF VILLEFRANCHE.

Julliénas, near Belleville.
Odénas, near Beaujeu.
St. Etienne-la-Varennes, near Belleville.
Romanèche, near Belleville.
Chénas, near Beaujeu.
Chiroubles, near Romanèche.

ARRONDISSEMENT OF VILLEFRANCHE.

Brouilly, near Belleville.
Morgon, near Romanèche.
Fleurie, near Romanèche.

ARRONDISSEMENT OF MÂCON.

Les Thorins, near Romanèche.
Moulin-à-Vent, near Romanèche.

These wines are generally known by these names. They are sold, according to quality, at from 130 francs to 250 francs for the 1866, and from 160 francs to 400 francs for the 1864-5.

THE MÂCONNAIS.—GENERAL DIVISION OF DISTRICT AND SOIL.

This district is situated around the town of Mâcon, also in the valley of the Saône. It may be divided into five belts, of which four yield exclusively red wines. The fifth, however, gives exclusively white wines. The first belt includes the Thorins and the Romanèche. This vineyard produces the finest class of the Mâconnais. The second belt is represented typically by the vineyard of St. Amour. The third belt is represented by the vineyard of Davayé. The fourth belt includes the whole district north of Mâcon, and the canton of Lugny. The wines of the latter are inferior to those of the other districts, and remain common, but the production is abundant. At first they are rough, but after some years they become very drinkable. North of this district there is the vineyard of Tournus, which produces an abundance of flat and dark-coloured wines. But this district no longer belongs to the Mâconnais. The fifth zone is represented by the vineyard of Pouilly, which gives the typical white wines of Mâconnais. Most of the good vineyards are situated on slopes, some of them being very steep. The soil is of nearly the same quality as in the Beaujolais, but the carbonate of lime is more frequently met with. White wines, in particular, are mostly grown on chalky soil. The rich alluvial soil in the valley of the Saône, which would give excellent cereals and fodder plants, now produces rough common wines, which go to supply the wants of the town of Lyons.

PREDOMINATING VINES.

Formerly the Pineau, known under the name of Bourguinon, was the exclusive vine of the distinguished growths; but this has almost entirely disappeared, and given way to the Gamay, which here is termed *bon plant* and *plant de la dombe.* There are three particular varieties of this Gamay, namely, the Gamay Picard, and the two varieties which we know also to be cultivated in the Beaujolais, the Gamay Nicolas and the Petit Gamay. We must here remark that these Gamays have nothing in common with that particular vine called the Gros Gamay, the planting and cultivating of which was forbidden by a law passed by Philip le Hardi, and the Parliaments of Metz and Dijon. The *bons plants* of the Mâconnais are not only great bearers of fruit, but they have also solid qualities for the making of wines. On the other hand, the apprehension must not be disguised—that if the viticulturists lose sight entirely of the qualities of the Pineau, and go in for quantity only, their vineyards will soon lose the reputation for quality which they once possessed. In the vineyards for white wines, the Chardenet, or white Pineau, which we also know to be the white grape of the Bourgogne and the Champagne, predominates.

MODE OF CULTIVATION.—VINTAGE AND TREATMENT OF RED WINES.

Plantations are effected by blind canes. The young vines are trained upon three horns, and cut short, two eyes being the average length. Dead vines are replaced by layers. When the vineyard has attained its highest age the vines are torn out, the soil is grubbed, then fallowed for some years, and again planted. The vines receive stakes only during the first years. All the cultivation of the soil is effected by hand by means of the mattock. The vine begins to bear in the fourth year, and is in full bearing in the sixth. The vintage in the Mâconnais begins between the 20th and 30th of September, or sometimes in October. The grapes are deposited in pails, and immediately crushed by means of the hand; but no particular crushing is effected after that, nor any removal of stalks, and the grapes are thrown into vats to ferment. The vatting is usually, and in warm weather particularly, short, lasting only thirty-six hours. In the lower parts of the Mâconnais the vatting lasts four or five days. The wine which is drawn, and the wine which is afterwards obtained from the murk by pressure, are mixed. The wines, when in the barrel, are treated in the same manner as the wines of the Bourgogne and Gironde. The Mâcon wines may be put in bottles after three, or four, or five years, their maturity depending upon the quality of the year. The wine is fined by means of white of egg. It is ripe for drinking six months after bottling. The wine of Mâcon is mostly sold in Paris, Lyons, and Geneva, provided it is of cheap quality. The better Mâcon wine is sometimes carried into the Bourgogne to be sold as wine of that country. We have tasted many qualities of the Mâconnais wines. Some were of the greatest purity, very alcoholic, and tremendously acid. It is much to be regretted that viticulturists of those districts do not employ scientific men to adjust the acidity of their wines to a proper quantum, for we have no doubt that their quality would be greatly improved thereby, although they would lose somewhat in the estimation of the French wine-and-water drinkers, who look only to acid and alcohol, and not to flavour. Physiologically, the Mâconnais of good years affect the constitution as the Burgundies do. Owing to their great acidity, the alcohol which they contain remains unperceived in the drinking, and shows itself only by headiness, and palpitation of the heart afterwards.

CULTIVATION OF THE WHITE VINE.—MATURING AND CHARACTER OF WHITE WINE.

The processes used at Pouilly and Fuissé are typical of those followed in the whole district. The white vines are also cut so as to form horns, but the canes are left very long, the exact length being regulated by the vigour of the plant; but it may be said that on an average each cane has ten eyes. Young vines begin to bear in the fifth year, and are in full bearing in the seventh. The vintage takes place at the end of September. The grapes are deposited in *baignoires*, and gently squeezed with the hands. They are then immediately pressed, and the must is allowed to run into the barrels. Fermentation over, the barrels are kept carefully filled, and the wine is drawn in March, and again racked in August. All the white wines of the Mâconnais district go to the town of Mâcon, and are thence transported to Paris. The Pouilly wine is dry, and possesses finesse and a nice bouquet. Its only fault, like that of the other Mâconnais wines, is that of being too heady. It is not so transparent as the Chablis, but has a more golden colour, preferred by many consumers. It is necessary to leave the wine for two years in cask before putting it in bottles. At the age of four years its vinosity and perfume are fully developed. The Fuissé is inferior to the Pouilly as regards finesse and generosity. It is, therefore, mostly employed to mix with Pouilly. Chaintré is less vinous and has less distinguished qualities than Pouilly, but it is a pleasurable sort of small wine, and of good taste. In the best vineyards of Pouilly the hectare yields about 18 hectolitres. The white wine of Pouilly, when bought at the vat, is worth about 50 francs the hectolitre. The wines of Fuissé and Solutré are rarely worth more than 40 francs.

CLASSIFICATION OF THE MÂCONNAIS WINES BY THE TRADERS OF MÂCON.

RED.	WHITE.
Prissé.	Pouilly-Fuissé.
St. Amour.	Fuissé.
Creusenoir.	Solutré.
Davayé.	Chaintré.

All in the immediate neighbourhood of Mâcon. The Mâcon post-office serves these localities.

CÔTE OF CHALON.

Under this name we comprise the vineyards of the arrondissement of Chalon-sur-Saône. Ordinarily, only common wines are here produced, but the better qualities have much analogy to the half fine wines and great ordinaries of the Côte d'Or. For this reason they are often sold as great ordinaries of the Côte d'Or, but they are less marrowy and have a less free taste. The vineyards are divided into three zones. The lowest is the plain. The others are the half côtes, and the côte called côteau. The plain yields only common wines. The half côtes yield wines of ordinary second quality. The best wines are obtained on the incline which commences north of Chalon, runs through Jivry, and then loses itself in the Mâconnais. The soil is chalk mixed with clay, silica, and oxyde of iron. Much of it is alluvial. The best growths of the Côte are protected by hills from the north wind, and the sun shines on them from its rising to its setting. They have the ideal exposure. The vines which here predominate are the Pineau, the Beurot, or Grey Pineau, which is the same as the German "Ruländer;" the Gamay; and the Giboudot, which is also called Malain, or "plant of Abraham." In this district, as well as in the Mâconnais and the Beaujolais, the desire for the production of quantity is increasing daily, and in consequence the black Burgundy grape is being diminished in numbers, and the more plenteous bearer, the Gamay, substituted. This will, no doubt, in the course of time seriously affect the quality of the wine of this district. The Gamay which is grown here is very similar to that of the other districts, but not identical with it. Its grapes ripen rather late, and as the grapes of the Beurot ripen early the vintagers are by this mixture compelled to harvest a little before the Gamay is fully ripe. This makes the wine more acid and less perfect than it otherwise might be. The variety of vine called the Giboudot has no virtue except its enormous fertility. Wherever it is introduced into vineyards it ruins the reputation of their wines. It has enormous grapes, with loose-hanging berries. These berries ripen late, and unequally; their skin is very thick, so that with the ordinary mode of vatting, where no pressure is employed to crush them, they remain entire. The wine obtained from them is violet red, harsh, and sour, and can be drunk only after it has been in the barrel many years. This grape might be grown in the plain, in places where no other good quality would grow; but it should never be allowed to enter the good vineyards, for, strange to relate, this vine has also the bad quality of remaining the same with all its faults, whether it is cultivated on the low plain or in the best exposure on the hill-side. It is probably to be considered as the prime cause of the loss of reputation which this district has sustained. A few white grapes are grown in this district, being the White Burgundy and a variety of Gamay. The latter gives an excessively flat wine. In the district of Mercurey there is still the vintage ban, but this will astonish no one who sees the general want of intelligence that characterizes viticulture in this part. The wines of the Chalonnais are sold in pieces of 228 litres. They mostly pass to Paris by Chalon. The wine of Mercurey has for many years had a great reputation. The merchants of Beaune bought this wine in order to mix it with Volnay, to which it was very similar, and of which it increased the small actual quantity, but with the gradual decrease of its quality Mercurey wine lost even this value. This has not been brought about only by the introduction of the Giboudot, but also by the want of care on the part of the proprietors and wine-makers. In this district it seems that the arrangement by which the vineyards are farmed out at the rent of half the crop does not work well.

We cannot, however, be astonished that viticulture everywhere should participate in the tendency allowed even in the administration of the best growths; for when Château Margaux, is sold at a fixed price of 3,000 francs the tonneau to speculators, the viticulture of Château Margaux must of course be directed upon the production of quantity, and is in fact so directed. How then can we blame the ignorant vigneron of the Chalon Côte for imitating the practice of the most intelligent and the richest wine-producers?

CHAPTER XIII.

THE WINES OF BURGUNDY.

Introduction.—Topography of Burgundy.—Varieties of vines planted in the Bourgogne.— Passe-tous-grains. — Pineau. — Gamay.— La Dole.— Beurot.— Chardenay.—Mode of cultivation.—Plantation in disorder.—Manuring.— Labour.—Grafting.—Summer treatment of the vine.—Vintage.—Vatting and fermentation.—Presses and pressing.—After treatment of the wine.—Area and classification of the vineyards in the arrondissement of Beaune.

INTRODUCTION.

It is probable that Burgundy is the oldest viticultural country in Central Europe, and that thence migrated the art of making wine to many parts of France and to Germany In the Middle Ages Burgundy was the standard wine on the tables of the great and mighty of the world, and a glass of Burgundy was the finest drink which any one could offer to his most honoured guest. When the reputation of Burgundy wine had been established, many proprietors without that district endeavoured to obtain the vine from which that beautiful beverage was produced; and the value of the plant may be estimated from the fact recorded in history, that reigning princes of Burgundy made presents of such vines to other princes whom they befriended. Thus the Burgundy vine migrated across the Rhine, up the Maine, into Saxony, Bohemia, and Moravia, and with it the peculiar mode of cultivating it which we see in Burgundy. The changes which taste in general has undergone also produced a change in the taste for Burgundy wine. The place which it formerly occupied in society is now taken by Champagne; and in those parts, for example, of Germany where formerly much Burgundy was drunk, now hardly any is met with.

TOPOGRAPHY OF BURGUNDY.

That part of Burgundy which produces the best wines of this department has been called by the French the *Côte d'Or*, or "golden hill-side." This is formed by a series of hills, about thirty-six miles in length, which stretch from Chalon on the Saône to Dijon in the direction of N.N.E. to S.S.W., their cultivated inclination and exposure being consequently wards the east. When in October we stood to the south of Beaune, and looked up the Côte, we saw the sun sink right behind the hills. They have a height of about from 200 to 300 feet, and consist of a loose chalk mixed with a little clay. Towards the east of these hills there expands an enormous fertile plain, which stretches right to the Jura Mountain. When one ascends any of the hills of the Côte in fine weather, one can see the Jura Mountain, and behind it Mont Blanc. Along these thirty miles of declivity an uninterrupted series of vineyards has been planted. They begin on the upper third of the hills, never ascending to the brow, and then stretch down the inclination into the plain, and frequently extend for a mile or two in the plain itself. The good vineyards are all situated about the lower third of the inclines. The property in the good situations is very much divided, so that a vineyard of five hectares is very rarely met with. An exception to this is the *Clos de Vougeot*, which has about 50 hectares of vineyard, and is surrounded by a wall. The vineyard of the Clos appears to the eye to be almost level, for the lower part has only 3°, and the upper better part has only 10° inclination. The *Clos Romanée Conti* has only about $2\frac{1}{2}$ hectares. Its inclination is only 3 to 5°. The *Chambertins* contain only 4 to 5 hectares, and that of only 8° inclination.

As these enclosed vineyards are the most noted of the many of the Bourgogne, and as the others which approach them in quality are also very flat, it may be said that a vineyard which has an inclination of above 10° in the Bourgogne does not belong to the first class. Along the higher regions of the hills many deserted vineyards with old terraces may be discovered. They tell their own story, namely, that the vine does not succeed above a certain height along the incline. We have observed a similar circumstance in the Champagne, where the black Burgundy grape did not rise up to the crest of the hill, but at the upper third was replaced by the white Burgundy. Thus nature limited the production of Burgundy on two sides—on the side of the mountain by spring frosts, and on the side of the plain by want of quality of the produce.

VARIETIES OF VINES PLANTED IN THE BOURGOGNE.

Burgundy has, like all viticultural countries, a mixture of vines in its vineyards, termed by the French *Passe-tous-grains*. The black grape peculiar to the Bourgogne, the Pineau or Noirien, is the dominating variety along the Côte; but in the ordinary situations, and in small vineyards, white and red grapes are found among the black. The Pineau is also the dominating grape in the Champagne. But by the side of it there is another variety, namely, the Gamay, a black grape of large berries, which is the dominant grape of the Mâconnais and Beaujolais. This latter grape gives a wine of much inferior quality, but the vine bears much more abundantly, for which reason it is preferred by those who get paid for quantity only. The must of the Noirien is much sweeter than that of the Gamay, showing 96° with the gravimeter when the latter shows only 84°. It is very difficult to distinguish the two vines where they grow mixed. The Gamay shows a stronger growth and development. Its leaves are a little blistery on the surface, and the lower side is a little felty, and the ribs are hairy. They are more easily distinguished by their fruit, that of the Gamay being larger in the berries and frequently showing some unripe ones, while the Noirien is always of equal ripeness in all its berries. Some assume the Gamay to be only a variety of the Noirien, and to have been first developed near the little village called Gamay. We do not know whether it is the Gamay near Blagny or near St. Aubin. This is the same vine which is planted at Bolle in Switzerland, and is there called *La Dole,* having been brought there from Dole in Burgundy. It has now been so multiplied in that part that a great amount of effervescent wine is manufactured from it at Vévais on the Lake of Geneva. It is not incredible that the Gamay should be merely a variety of the Pineau, inasmuch as the tendency of the Pineau to form varieties is no doubt very great. Another variety which frequently occurs in Burgundy is a light red one called Beurot, known in Germany as Ruländer. Of white grapes there is the Chardenay or White Burgundy, which is grown in the Champagne in the higher lying vineyards, but also mixed with the other vines, and prevails in the northern part of Burgundy, yielding among others the celebrated wine of Chablis.

MODE OF CULTIVATION.

In Burgundy, the method of renewing the vineyards by sinking canes is prevalent. It is, therefore, not customary to cut out vineyards entirely and plant them afresh. Where, however, such a process becomes desirable from epidemic diseases, exhaustion of the soil, or wish on the part of the proprietors to effect changes in the inclination, the ordinary method is adopted. The soil is grubbed for a depth of a foot and a half to two feet. Then fallow plants are sown, and when half grown they are dug under. After such an improvement of the soil has been carried on for two or three years, blind canes are planted, or—which is frequently preferred—young plants with roots. They are planted in lines, at distances from a foot to a foot and a half. They are then allowed to grow, are manured, cut for the first time in the third year, dressed upon two spurs in the fourth year, provided with stakes from 4 to 5 feet in length, and then allowed to bear fruit. When rejuvenescence becomes desirable, they are laid in the ground in the same manner as we have seen in the Champagne, and described in Chapter III., p. 74. But in Burgundy this rejuvenescence is not effected with the same regularity as in the Champagne, and we have seen in many parts, particularly along the Côtes of Beaune, vines which must have had an age of at least ten, fifteen, or twenty years. Here sinkers were laid in the ground only for the purpose of replacing vines which had died out. When the vine is fully developed, there are only two spurs left, an upper bearing spur of three eyes, and a lower growing spur of two eyes. By the repetition of this cutting year after year, the vine gradually rises from the ground, and in the course of eight or ten years obtains a height which has two disadvantages: firstly, the stakes cannot carry the plant any longer; secondly, the grapes get too far away from the ground, and do not ripen sufficiently. Then it becomes necessary to sink the vine into the ground, and form a new vine by its one year's canes at a little distance from its former place. The cutting of the vine in spring offers a peculiarity. While in all other viticultural countries which we have visited, the workman takes his knife and cuts the cane which he holds in his left hand upwards, drawing the knife towards himself, allowing the cut-off part to fall to the ground, in Burgundy the labourer seizes the part of the cane to be cut off with his left hand, inserts the knife underneath the hand and cuts downwards, or away from himself. Each plant prepared as above related shoots three new canes, and these are allowed to grow until the middle of the summer. They are tied together at the top, and commonly when the grapes begin to colour the tops are cut off, excepting, however, all canes which it is intended to sink. These are allowed to grow to their fullest possible length. The sinking is done partly in autumn and partly in spring. We have seen it performed in the neighbourhood of Beaune in the beginning of November, at the same time that the winter hoeing was being performed. The vines had been cut, and the labourers were turning the ground with their *pioches*, and when they came to a part where a sinker had to be made they dug a ditch with the same instrument, immersed the cane, and covered it with earth.

As the reproduction of the vine is very irregular, the vineyards of Burgundy do not present that remarkably cultivated and orderly appearance of the vineyards of the Champagne. On the contrary, the peculiar sight is one of extreme inequality, very young vines being mixed in all the vineyards with very old ones, and very low ones with very high ones. The soil, moreover, is not kept as even as that of the Champagne, it being mostly stony and chalky, and the ditches which are made for the purpose of sinking being left partly uncovered till the next year, in order to receive a quantity of manure or compost earth. As this sinking is going on constantly, and as every year about one-fifteenth of the vines are sunk, so that

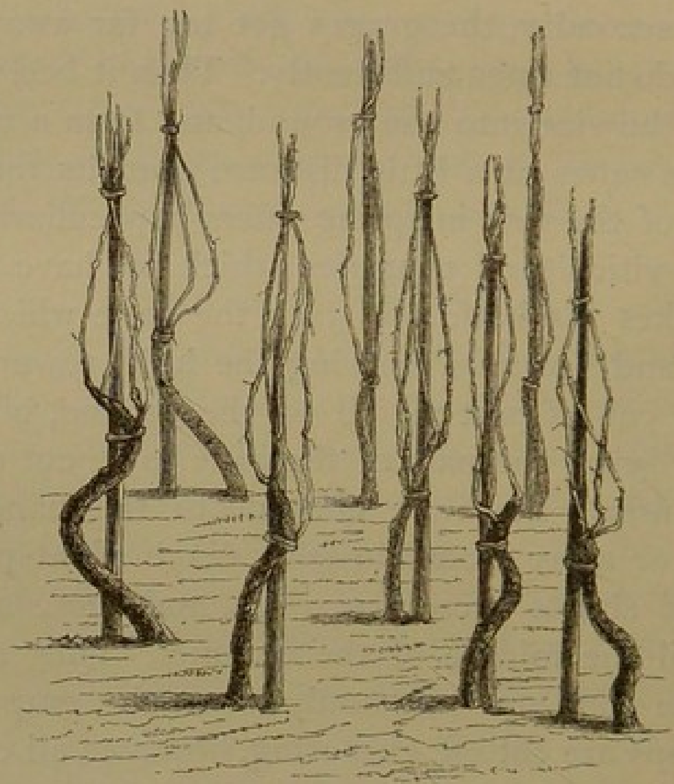


FIG. 67.—View of vines bearing the red Burgundy grapes in the Côte d'Or. (P. eau c fins.) Irregular plantation ; high footings.

the whole vineyard is rejuvenesced in from ten to fifteen years the vineyards look as if they had been rummaged by pigs.

MANURING.

A common manure is the murk. From the end of October throughout the winter one can see large masses of murk being carried up the mountains into the several vineyards, and distributed to the various vines. In many parts of Burgundy this is the only manure which the growers allow or profess to allow, for there is a curious belief that vineyards which have not been manured give a more fiery and darker-coloured wine, and a wine which becomes more quickly clear than vineyards which have been manured with animal dung. But we cannot suppose this belief to exist among rational viticulturists, for nothing could be more erroneous and more contrary to the experience of the best situations in the world. [See Johannisberg and Steinberg, and the cultivation of the Gironde, where we have fully exhibited the important share which the rich manuring of these splendid growths bears in their magnificent product.] In many properties manuring with stable dung is carried out as elsewhere.

LABOUR.

The work in the vineyards is done by hand, for which

FIG. 68.—Effect of pinching bunch-stalks. Above an excessively long bunch, which if it had been cut at the proper time, in the place indicated by the line, would have assumed the same favourable development as the lower bunch, which was thus pinched during its early growth. Common practice in the Jura.

purpose they are divided into *ouvrées*, or areas, which give a day's work to a man. Such an *ouvrée* has 3,645 square feet. In each of them about fifteen or twenty vines have to be sunk every year—a labour which is included in the contract. If more vines have to be sunk, one sou per vine is paid. In many parts of Burgundy, however, the old arrangement prevails by which the labourer does all the work in the vineyard, receiving half the harvest as his payment. He generally has from three to four hectares, which he and his family cultivate. He carries all the earth and manure, finds the poles or stakes, performs the vintage, presses the wine, and, in short, does every operation until the wine is in the barrel. In parts where the wines are very good and high in price the viticulturist has yet to bear the half of the taxes and communal imposts. The proprietor, however, allows him collateral advantages, in the shape of plots of land for the keeping of animals, and free lodging. This peculiar practice of dividing estates into vintageries as we will call them, or vigneronnages, has been carried into Saxony, particularly into the neighbourhood of Dresden, where the whole vine-producing district is cultivated upon the pattern of Burgundy. This system has been most developed in the Mâconnais.

GRAFTING.

The method of laying the vines which is carried on in Burgundy is frequently joined with simultaneous grafting. There are plants which, although of a proper variety, are not abundant bearers ; and it is well to improve these by the process of grafting. This has the advantage that grapes may be obtained in the very first year, and that, consequently, if it be adopted on any large scale, the time otherwise lost by replanting will be saved. The foot of the vine to be grafted is freed from earth, the so-called dew-roots are cut off, and everything is arranged for laying the vine. A branch is now selected at a height of from one and a half to two feet from the ground, where there is good two-years' wood. This is cut in such a manner that there are at least two inches of two-years' wood left. This is split with the knife for an inch and a half. The graft, which is a cane of one year's standing of some feet in length, having at its end two to three inches of two years' wood cut in the shape of a wedge, is now inserted into the slit of the stump, so that the bark and plinth of one side fit the bark and plinth of the same side of the stump. Of course it is better if the branch is so selected that the bark and plinth on both sides fit upon each other. The joint is now wound round with wool-yarn, or straw, or hemp, and the whole plant, including the union, is sunk into the ground, and bedded in, as well as covered with good mould free from stones. At the proper place the graft is bent upwards, cut upon two eyes, tied to a stake, and allowed to grow. If it be desired to let the new vine come forward in the place of the old foot, it is only necessary to turn the graft in a circle, which requires, of course, a circular hole. The peculiarities of this method of grafting are twofold. In the first place, two years' wood is grafted upon two years' wood, while in most other grafting—that of fruit trees, for example—one year's branches are grafted upon wood several years old. One year's wood of the vine may also be grafted, but it is not so certain to take as two years' wood; and this difference arises most probably from the thinness of the bark of the one year's wood. A second peculiarity is, that the union is sunk into the ground. This has the advantage of keeping the junction moist, and allowing of a healing of the wounds by a process which is partly bark-growth and partly root-growth. This healing underground is perfect, and a sound union is obtained, while a vine grafted in this manner above ground never sets a sound union, but always rots in the pith.

The grafts to be used in this operation, according to the Burgundy method, have to be cut a month before the grafting. In particular, they have to be removed from the vines before any sap has risen. It is therefore advantageous to cut them in the month of November, before the frost, and to put them in a cellar, covering them with earth or sand. By this proceeding they obtain a sort of individual life, which makes them more inclined to take.

SUMMER TREATMENT OF THE VINE.

The soil is turned by hoeing, in May. The hoes are very short, and the angle at which the iron is bent upon the handle is very acute. The consequence is that the working of the ground is not carried to any depth. If attempted, it is found very difficult on account of the many stones contained in the soil. At the same time the vines are freed from all unnecessary shoots, and everything is concentrated into the three branches which the vine is allowed to grow. The branches are tied up in June loosely, so that they form a basket within which the blossoming can take place. In July, after blossoming, the branches are tied once more, higher up. Towards the autumn the tops of the vines are cut here and there. In August the soil is worked once more in order to remove all weeds until at last in September and October the time of the vintage arrives. In November and December the stakes are drawn and put together in round heaps; but we have also seen in many parts that the stakes were drawn and the vines were laid flat on the ground, the stakes being used to weigh them down, and stones being laid where the stakes were not heavy enough for the purpose.

VINTAGE.

In favourable years the vintage takes place in the latter half of September, but in less favourable ones in the first half of October. It is supposed that the vintages which take place in September yield a better wine than those which take place in October. All enclosed properties have, of course, perfect liberty to collect their grapes when they please; but the small proprietors, whose growths form the great bulk of the general vintages, are obliged to obey a certain communal law which is called the vintage ban. It is the product of a silly avarice. According to this regulation the vineyards are to be protected by keeping everybody out of them from the time the grapes begin to ripen until the time of the vintage. The proprietors are not allowed to enter their vineyards except, perhaps, once a week, during an interval which is announced by the village bells. When the grapes are ripe a commission is appointed, consisting generally of the mayor, a proprietor, a practical vintager, and one merchant. This commission visits the vineyard and forms an opinion whether or not the grapes ought to be collected. When they have determined the time, they announce it to the mayor or the prefect, and it is published by the town-crier or by other means. We have already in several places shown the absurdity of this miserable law. The Gironde ridded itself of it during the Revolution. At the same time it was abolished in Burgundy, but it returned with the Restoration. In the Rhenish provinces of Germany it was also abolished, and now remains only in a modified form; but in Würtemberg, and some of the wine-producing countries on the other side of the Rhine, it has continued to exercise its baneful influence in the same manner as in Burgundy: for he who has early ripening grapes is obliged to let them hang until the late ripening grapes in the district have attained a tolerable maturity; and when he comes to his vineyard he finds his crop either eaten by the flies, or rotten, or over-ripe, and in any case yields him a lesser quantity or quality of wine. He who has late ripening grapes, cannot let them hang to ripen, because from the moment that the vintage is over he loses the protection of the public custody of the fields. The consumers of wine will thus see that they are grievously injured by this law, which produces either loss of quantity or quality, and prevents that exercise of liberty in the administration of property which alone is capable of producing economical results. Here, as in the Champagne, the vintage is performed by strangers who flock to the country from the neighbouring villages. The terms upon which they give their labour are, in general, the same as those which we shall describe as prevalent in the Champagne. Some of the labourers in the vineyards cut the grapes. Others carry them to baskets which are put up here and there. These baskets are in general the same size and shape as those used in the Champagne. The places where such baskets are standing are marked by high stakes that the porters may know where to carry the hand baskets when they are full. The large baskets when filled in their turn are then placed on the backs of men, who have strapped to their shoulders peculiar instruments by which to fix them. The baskets are then placed side by side at the margin of the vineyard if it abuts upon the carriage-road, or they are carried to the nearest carriage-road. At the appointed time a cart drawn by a horse arrives. In the cart is a large oval vat looking like a large bathing tub. The carter now takes off his boots, turns his trousers up above his knees, and stands in the vat, or ballonge. The porters now hand basket after basket to the carter, who empties them into the vat, and then treads the grapes down as fast and as firmly as he can. About twenty baskets of $3\frac{1}{2}$ feet in length, and $1\frac{1}{3}$ feet wide and 1 foot high, go into such a ballonge. When the vat is full the carter dismounts, rubs his feet upon the nearest bundle of grass, puts on his boots, drives the cart home, and takes care that the grapes are immediately put into the large vats. This done, the carter returns to the roadside to fetch a similar load, and again takes off his boots to tread down the grapes with his unwashed feet, as before. In this manner the great bulk of Burgundy grapes are carried home, but we have also seen instances in which the grapes were cut and selected and carried home in a more cleanly manner. In these cases the stalks were removed and the berries treated by themselves. Here, as in the Champagne, many of the grapes are sold while hanging on the vines. The proprietors collect them according to the prescription of the purchasers. Many wine merchants buy the whole harvest of a vineyard and collect the grapes themselves. Frequently the grapes are bought after collection by the proprietors, and during the vintage a trade is carried on along all the roadsides of Burgundy: there are the basketsful of grapes, and anyone who likes can come and buy. The grapes are measured by *feuillettes.* These are barrels of 114 litres' capacity, being half a piece or a quarter queue. The half queue or entire piece in Burgundy, therefore, contains 228 litres. The feuillettes used for measuring the grapes are provided with two iron handles. The grapes are filled in without pressing, and when the vessel is brimful the grapes are heaped on the top as high as possible. Ten feuillettes full of grapes generally give one queue or two pieces of wine; or 1140 litres of grapes give 456 litres of wine. That is to say, $2\frac{1}{2}$ bulks of grapes give 1 bulk of wine.

VATTING AND FERMENTATION.

After the grapes have been carried home they are taken out of the ballonges, and, in the half-crushed condition in which they then are, put into the vats or cuves. This is done by lifting the ballonge to the margin of the vat and pulling out the grapes by means of a kind of hook called a *grappe*. By this instrument many of the berries which have before escaped are now crushed. Of course in the process of crushing by the feet and the grappe a great many of the ripest berries are broken, but the harder and less ripe berries remain unbroken. It is supposed that this fact is of advantage in the following way. While fermentation proceeds the unbroken berries are subject to a considerable amount of warmth in the fermenting fluid, which is supposed to act beneficially upon the production of sugar in their substance. When the first fermentation is over and the wine is drawn, the murk is subjected to pressure: these berries are now crushed, and a new quantity of sweet must is brought into the wine already fermented. By these means a more powerful second fermentation in the drawn wine is produced, which the viticulturists regard as advantageous to their product. The separation of the berries from the stalks which is practised by many careful viticulturists, will of course dispense with this advantage; and we must say that we consider the explanation above given to be at least unproved. We have the greatest doubt that mere warmth can increase the sugar in a grape, for as the grape contains no starch, the process of transformation which we know to take place in malt, or by the agency of malt, cannot take place here; but the production of sugar in the grape is a process which is accomplished independently of starch, and effected from products the nature of which we do not know at present. The cuves in which the grapes are put to ferment are generally higher than they are broad, and narrower at the top than at the base. The shape has practical advantages on account of the facility with which the hoops can be kept tight. Their height is between 5 and 6 feet, regulated by the height of a man who, as we shall see, will presently play an important part in the cuve. These cuves are not provided with a hole at the bottom for letting off the wine, but throughout Burgundy the wine is drawn by means of syphons. The cuves are therefore raised only one foot from the ground, instead of three or four feet as they are in the Gironde. Every proprietor endeavours to fill a cuve in one day. Some of them are in the habit of moistening the inside of the cuve with brandy, to take away what they call the taste of the wood ; but as they do not afterwards remove the brandy with the woody taste from the cuve, the process results in an addition of spirit to the wine. The cuve is filled to within a foot from the top. A narrow basket of the height of the cuve is fixed to the inner side and serves as a well, or space free from the murk of the grapes, from which the wine is drawn by the syphon after fermentation. In many parts of Burgundy the addition of sugar to the must is very common. We have witnessed this addition, which, in some cases, amounted to 20 lbs. to the piece. We believe that much of the fieriness and alcoholicity—and so-called "headiness" of Burgundy wine, of which amateurs complain—arises from this addition of sugar, and that more objectionable properties are by no means natural qualities of the general products of the Côte d'Or. We are, however, willing to admit that the increased alcoholicity may contribute to preserve Burgundy better than it would keep in its ordinary condition. The wine in the cuve is now allowed to ferment until it is ready to be drawn. A quick fermentation, which may be accomplished in from four to six days, is preferred to a slow one ; for a quick fermentation has the advantage of creating greater warmth, and effecting a better extraction of the colouring matter by the alcohol formed, as well as a more perfect decomposition of the sugar.

While the fermentation proceeds the murk rises to the top as in all similar fermentations, and forms what is technically called the "hat" or *chapeau*. The chapeau, being penetrated with gas, of course rises above the level of the liquor. As long as the chapeau continues to rise or remains stationary, the fermentation must be allowed to proceed. If a low temperature should ensue, it is necessary to warm the fermenting-room by means of stoves. It may with advantage be kept at a temperature of between 20 and 30° Réaumur. The moment the chapeau begins to sink, it is necessary to draw the wine in order to prevent the upper or somewhat spoiled and acetified part from coming into contact with the wine and imparting to it a disagreeable taste. The sinking of the chapeau, however, is not the only criterion of the moment at which the wine is to be drawn. The vintager takes from time to time samples of the wine from the well, by means of a small syphon, and tests them with an areometer. This areometer is so arranged that its zero indicates the point at which the sugar has completely disappeared. The colour of the wine is also ascertained by means of a small vessel called a tasse, embossed with hollows, bumps, and ridges, and highly polished, so that the light can be reflected through the wine in all directions. The wine is not often drawn before it is of a sufficiently deep colour.

Now comes a phase in the production of Burgundy which is unparalleled by any proceeding in any wine-producing country. The fermentation is complete, and the wine has to be drawn; but it is desired to impart to the wine all the colour that can be extracted from the husks. For this purpose the husks which are collected in the chapeau have to be thoroughly mixed with the alcoholic fluid. The top of the chapeau, which is mostly a little rotten and sour, is therefore taken off, and two or three men having laid aside their clothes mount to the top of the chapeau. The chapeau is so dense that the men can stand upon it for some time. Each of the men works a hole with one foot through the crust; he then gets his other foot through, and gradually succeeds with much trouble in causing his body to sink down through the crust, into the wine below. While thus engaged the whole chapeau is broken to pieces and worked together with the wine. These men now work the whole of the murk, and mix it thoroughly in all directions with the wine for about half an hour. They then emerge from the liquid covered with a dark red dye, and after wiping their bodies with the shirt they pulled off, they put on a fresh shirt, and re-dress. After the lapse of several hours the chapeau has again risen as before. The men then again descend into the fluid and mix it with the chapeau as before. During this operation the men perspire profusely, not only from the intense labour which they perform, but also from the poisonous effect of the carbonic acid gas exhaled by the fermenting mass. They are mostly deadly pale or blue, and pant and hang their heads over the edges of the cuves, gasping for fresh air. We can approve this method of effecting the *foulage* as little as the dirty methods of treading the grapes which we have observed in the Gironde. The fact that these operations are carried out on a very large scale does not justify the introduction of disagreeable associations, and we hope that our remarks may contribute to effect a change for the better. In the smaller establishments the grapes are trodden and then allowed to stand in larger or smaller cuves until the fermentation is complete. During fermentation the proprietors either cover the cuves with a wooden cover, which they lute down by means of loam and clay, or they put a layer of loam and clay, frequently mixed with cow-dung to give it cohesion, upon the chapeau itself. No wonder, then, that much of the wine that is made in Burgundy has a strange, disagreeable taste and does not keep; that along this Côte there is made not only the best wine in the world, but also the worst; that in not a single hotel or inn along the Côte a single bottle of Burgundian wine fit for any traveller to drink is to be obtained. No wonder that the Bourgogne wine is subject to those many alterations which the Burgundy people, in their ignorance, call "diseases," such as bitterness, an alteration almost peculiar to this wine and not met with in any other class, and that it requires an amount of "doctoring" claimed by no other product.

The wine is next drawn by means of a syphon fixed in the basket already mentioned. It is put into pieces of 228 litres each. The after-fermentation is completed in the cellar, and the wine is drawn in February and is ready for sale in March. Common wine may be drunk at the end of the first year. The good wines require four years in barrel and several years in bottle, before they develop their full qualities; but during that time they give to the proprietors and the wine merchants such an amount of trouble, that Burgundy may well be called the wine merchant's "child of anxiety."

PRESSES AND PRESSING.

When the wine is drawn, the murk of course remains in the cuve. This may be treated according to the process of Petiot, which we have described, with sugar water, and another wine may be extracted; or it may be—and more commonly is—put upon the press, and the wine thus obtained is added to the other wine drawn by the syphon. The murk pressed dry is then used for the purpose of making piquette wine for the work-people of the estates. The presses in use in Burgundy are the long beam presses, which we also still find in Würtemberg and many other parts to which viticulture has come from Burgundy. The beams are of oak, and are from 30 to 40 feet in length; and their pressure is exercised upon a space 12 feet square. The weight at the end of the beam consists of an enormous wooden box containing many hundredweights of stones; but in some places we also saw a great millstone suspended to a beam 50 feet long. The millstone was made to exercise its weight by being drawn up by an enormous screw, which passed through the end of the beam. In some parts the presses are of the same shape as those commonly used in the Champagne; but since it has been found that the murk may be pressed sufficiently by a power which is about one-tenth of that which these enormous instruments can exercise, the press commonly used in the Gironde, with one central screw, gradually takes the place of these old, clumsy, and in many cases but too efficient instruments.

AFTER-TREATMENT OF THE WINE IN BURGUNDY.

The wines are mostly drawn in small casks. But in large properties—for example, the Clos Vougeot—the wine is laid

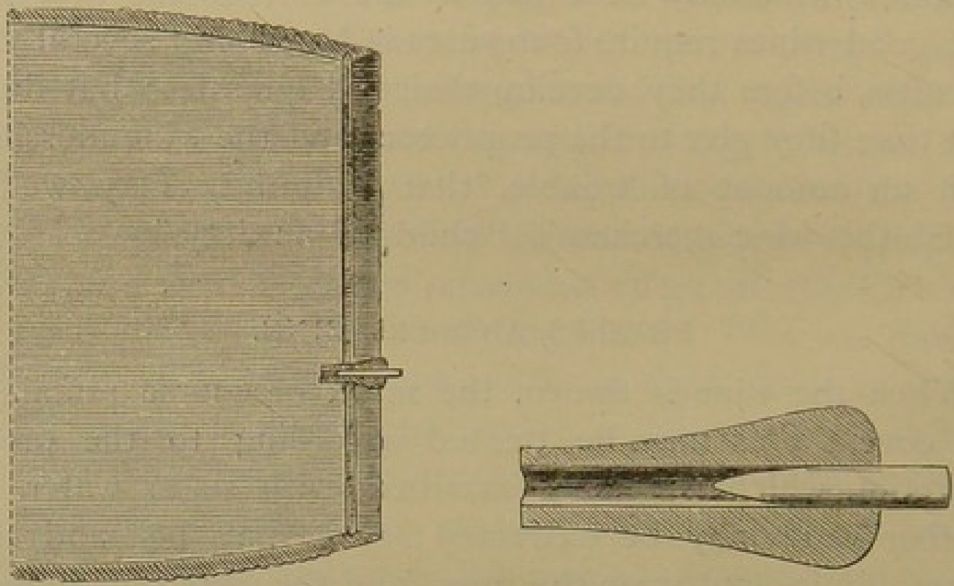


FIG. 69.—Section of a full cask with the tube-spigot inserted. On the right the tube-spigot of its natural size. These spigots are manufactured at St. Claude, and are termed *guillettes*. They are peculiar to the Jura.

in barrels containing from ten to thirty pieces, and is drawn into small pieces only after it has been sold. The wine after the first fermentation, and in either the large or the small vessels, is mostly laid into the *chais*, and is not allowed to come into the same room with older wines, because it is supposed that the presence of young wine is detrimental to old wine. Probably, however, convenience in the order of things has more to do with this restriction than the supposed danger. During the time that the wine is in the *chais* the barrels are kept carefully filled to the bung (*ouillé*); the can used for this purpose is called a *croc*. The fining is effected by means of white of egg.

The wines of Burgundy are sold by the *pièce*, the *feuillette*, the *quartant*, or the *bouteille*. The *pièce* contains 228 litres; the *feuillette*, 114 litres; the *quartant*, 57 litres; and the *bouteille* 75 centilitres, or three-quarters of a litre. In the case of great wines the price of the cask is always included in that of the wine. Quotations are mostly *loco* Beaune.

AREA AND CLASSIFICATION OF THE VINEYARDS IN THE ARRONDISSEMENT OF BEAUNE.

These vineyards are planted with Pineau vines exclusively, and produce the so-called great wines of Burgundy. They are situated in nineteen communes, arranged in the order in which they occupy the Côte d'Or, beginning at Santenay and ending at Dijon. It is calculated that on an average ot years, each hectare planted with pineaus produces an annual harvest of 15 hectolitres, while the common varieties of vines produced from 50 to 60 hectolitres per hectare. The data are extracted from the published statistical tables of the *Comité d'Agriculture de l'Arrondissement de Beaune.* This publication also contains a good map of the Côte.

Names of Villages.	First Class.	Second Class.	Third Class.	Total.
	Hectares.	Hectares.	Hectares.	
Santenay	40	114	96	250
Chassagne	76	103	81	260
Puligny	42	27	16	85
Meursault	110	100	103	313
Auxey	none	23	19	42
Monthelie	13	53	30	96
Volnay	91	47	75	213
Pommard	113	114	102	329
Beaune	270	120	143	433
Savigny	92	116	168	376
Pernand	26	33	39	98
Aloxe	92	36	72	200
Serrigny	10	10	5	25
Prissey	—	5	—	5
Premeaux	34	20	3	57
Nuits	68	82	96	246
Vosne	48	44	75	167
Flagey	49	14	9	72
Vougeot	54	6	2	58

CHAPTER XIV.

THE WINES OF THE CHAMPAGNE.

Topography.—Northern and southern districts.—Description of the route of a tour.—Soil of the Champagne.—Preparation of the soil, planting of vineyards, and cultivation of the vine.—Value of the vineyards.—Varieties of vines grown in the Champagne.—The vintage in the Champagne.—Pressing, fermenting, cellaring and fining of the wine.—The drawing into bottles (*tirage*).—Fermentation.—*Casse*.—Clearing of the bottles of yeast, or disgorging.—Liqueuring, corking, and finishing.—Varieties and qualities of champagne, and quantity and increase of its production.—Short history of champagne and its manufacture.—Scientific consideration of the champagne preparation process.—Phenomena of absorption of gas.—Experimental determination of tension or pressure in full champagne bottles.—Schinz's Manometer.—Treatment of champagne claret for *mousse*.—Adjustment of acid and alcohol in claret.—Changes in the physical condition of champagne by disgorging.—Quantity of carbonic acid gas evolved from a bottle of sparkling Moselle.

TOPOGRAPHY.

THE Champagne is an ancient province of France, situated under the 47th, 48th, and 49th degrees of latitude. At the division of France into departments it was cut up into four parts, which were respectively united with the departments of the Ardennes, the Marne, the Upper Marne, and the Aube. The wine to which this district owes its reputation is not obtained in all these departments, but only in that of the Marne, which includes the prefectures of Châlons-sur-Marne, Epernay, Rheims, Saint-Ménéhould, and Vitry-sur-Marne. These districts contain 19,589 hectares of vineyards, which are situated on the territories of 453 communities, and belong to 27,018 proprietors. An average vintage produces about

700,000 hectolitres. Of this, more than a quarter is drunk by the inhabitants themselves. Now, although the five districts yield wine, yet good wine is produced in only two of them; namely, the prefectures of Rheims and Epernay; and the manufactories of Champagne wine which are at any distance from these districts are obliged to draw their main supplies from them. The vineyards of the district of Rheims are situated around the slopes of a wooded mountain which is called the *Bois et Montagne de Rheims*. No vines grow in the plain, and none grow above a certain height on the slopes of the mountains. About one-half of the vineyards lie on the north-eastern slope, and the other on the southern slope of this little mountain. In the former are situated the celebrated growths of Bouzy, of Verzy, and of Verzenay; and if the tourist who visits the Champagne starts from Bouzy, and walks along the road northward and north-westward, he will gradually pass all these celebrated places one by one, and terminate his tour at Villers, a few miles south of Rheims. The growths situated on the southern slope include Ay, Haut Villers, and a number of other names which we shall have to mention hereafter. These latter vineyards extend from the slope of the mountain very near to the border of the Marne, but the plain in which the Marne itself flows is destitute of vines. The *second district* lies south of the Marne, and its centre is Epernay. It is bordered on the west by the forest of Anguien, the smaller one of Brugny, and in the south by that of Vertus. It is one splendid continuous vineyard, and, besides the growths of Epernay, yields those of Cramant and Avize.

It is very difficult to explain the circumstances of situation and climate to which the growths of the Champagne owe their excellence. The soil is chalky, or sandy, or clayey. The vegetation in the whole district does not show any particular signs of luxuriance. There are no plants indicating a warmer climate than that which the latitude would lead us to suppose; and the northern district, which slopes towards the north-east in particular, would, on theoretical grounds, be supposed to be very unfavourable to the growth of the vine; for throughout the world we find that the declivities of mountains, sloping towards the south and exposed to the sun, are those which produce the best wine, and that eastern and western exposures are much less favourable, and northern declivities almost unproductive. We have therefore to seek for an explanation of the exception which the northern slopes of the Champagne form to this rule, not in these situations themselves, but in their relations to the neighbouring land. To the north and east of the Bouzy and the Verzenay district extends a great plain, over which the sun exercises a free influence so as to warm the soil during the daytime to a very high temperature. Much of this land is barren, and bears only a few wretched pines. It is termed the "lousy Champagne" (*Champagne pouilleuse*). Another part is cultivated, but no part of it is so covered by vegetation as to prevent the sun from striking the soil. Now, it is observed that during the whole of the summer months, from June to September, the prevailing current of the air over this plain is in the direction of the mountains of Rheims; the air thus passing abstracts heat from the soil, and thus, on reaching the vines, not only adds to the direct effect of the sun upon them, but is an auxiliary to their progress during the evening and throughout the entire night. This phenomenon is, in our opinion, fully sufficient to explain the magnificent development which the vines and grapes attain round the whole of that *Côte*.

It is now necessary for us to describe the topographical circumstances more at length. The wine-producing part of the Champagne from its extreme north, namely Rheims, to the southernmost point, Vertus, has a diameter of about 45 English miles. The centre of the whole district is Epernay, on the borders of the Marne. The slopes of Verzenay, Verzy, Saint Basle, Villers, Marcmary, and Bouzy, are gentle. They represent a series of rounded promontories running out from the main mountain, the gentle valleys between which, down to the beginning of the plain, are all covered with vines. But the slopes of Mareuil, Ay, Dizy, and Haut Villers are more rapid. From the heights of Ay, one can see the extent of the whole Côte of the Marne in an easterly as well as a westerly direction, and also perceive a great part of the vineyards south of Epernay.

The vineyards south of Epernay are not situated upon any particular slope, but extend over an undulating plain, southwards down to Vertus. From Pierry in the direction of Montelon, Cuy, Cramant, Avize, Ojer, and Le Menil, down to Vertus, the territory consists of an irregular accumulation of small chalk hills or chalk mounds which slope towards the east and do not give good exposures. Epernay has 6,000 inhabitants, its only trade being in wine. Rheims has 40,000 inhabitants, and, besides a remarkable trade in wine, has a very important industry in spinning, weaving and dyeing, particularly of woollen goods. To the east of the Champagne wine district, and almost out of it, lies Châlons-sur-Marne, which has 13,000 inhabitants and an important trade in wine. This localization of the manufacture of champagne at Châlons is due almost exclusively to the circumstance that the chalk hills running along both sides of the valley, are composed of so favourable a material that large cellars which do not require any masonry to support them can be easily excavated. In consequence, these chalk hills are pierced like honeycombs, and millions of bottles of champagne are constantly stored in them, and sent out of them to all parts of the world. In coming from Rheims toward Sillery we observed a little plot of vineyards said to be the celebrated Bruyères de Mailly, which used to form the pretext for the so-called Sillery wine. The château of Sillery formerly belonged to the widow of Marshal d'Estrées; and as she possessed some of the finest vineyards in Verzy and Verzenay, and caused their products to be treated with particular attention in her cellars at Sillery, this name obtained a notoriety which its ten acres of vineyard actually situated there could never have obtained for it. The château afterwards went into the possession of Madame de Staël;—later, into that of M. Ruinard de Brimont. Its present proprietor is M. Jacqueson of Châlons. Not very far from this little château is the estate of Romont, to which now a great part of the Bruyères and some of the vineyards at Verzenay belong, which yield the best so-called Sillery. This property is owned by M. Paul Chandon of Epernay.

We started from Sillery and walked to Verzenay. The road crosses the great canal repeatedly, then goes along it, and suddenly turning to the right, tends towards the mountain. From this road a most lovely view of Verzenay is enjoyed. It is a bright village lying on the high part of the saddle which two promontories projecting from the main mountain form. Behind it is the green forest of the mountains of Rheims. In front of it are open cultivated plains, and the tops of the two hills which mark its lateral limits are surmounted by two enormous windmills, which impart to the beautiful view a kind of animation. The soft verdure of the expanses of vineyards is most pleasing to the eye. Passing through the vineyards and the village, we went across the heights towards Verzy and St. Basle, the character of the country remaining much the same; but as the promontories ran more towards the east, one of their declivities formed a good southern exposure. The best among them were at Contures and Minets. We everywhere perceived that the lower part of the *côtes* bore the black Burgundy grape, while in the higher parts towards the forest the white Burgundy grapes were mostly grown, but in many parts of the vineyards which we visited we saw a few white Burgundies among the black. Having passed Verzy, we found an interruption in the continuity of the vineyards of several miles in length; but, continuing our journey southwards, we came to Bouzy. This is celebrated for its red wine, the so-called still red champagne; but many of the grapes grown there are also used for making white champagne. The soil is chalky, has a strongly red colour, and contains many pebbles. A few miles south of Bouzy ends the viticultural district of the *côte* of Rheims; and the traveller passes ordinary fields towards the Marne to enter upon the southern *côte* at Mareuil. In wandering through the splendid situations of Mareuil, Ay, Dizy, and Haut Villers, we saw an uninterrupted, undulating, splendidly green vineyard, wound like a mantle round the slopes of the Rheims mountain. Below Haut Villers, which, as its name indicates, is situated rather high, and nearly opposite Epernay, the mountain projects more towards the Marne, corresponding to a similar projection northwards of the mountain which runs behind Epernay towards Pierry. By this arrangement a wide kettle-like valley is formed, in which Epernay appears as the inhabited centre. Among the hills which form the best situations from Mareuil to Haut Villers, the mountain of Ay is distinguished by its form, inclination, and exposure. It has a height of about 200 feet and an inclination of about 20°, being exposed towards the south-south-west. Upon its side lies the village of Ay, which in its environs has many beautiful gardens and villas, giving signs of opulence and well-being. Indeed, Ay is the most lovely place in the whole Champagne. The *côte* runs uninterruptedly by Dizy towards Haut Villers, a length of six English miles. Here mostly black Burgundy grapes are grown. Most of the vineyards of Haut Villers lie below the village and have a very strong inclination, that of the Côte de Lerais amounting to 26°, and not being interrupted by terraces. Seen from a little distance, the town seems to crown a mount of vines. Its best situations are called *les quartières* and Hataut. From Haut Villers viticulture is continued along the right bank of the Marne to Chatillon. Passing now to the south of the Marne, and starting from Epernay to Pierry, we found that the exposure of the vineyards became south-easterly. The neighbourhood of Pierry has many vineyards, and the vegetation is here much richer than in other parts of the Champagne. The grapes are larger and blacker, so that one is almost tempted to think they are another kind. In this part the variety called *meunier*, or miller-vine, is often blended with others. It is easily recognized by the white felt which covers the dark green leaves, and gives them an appearance of having been dusted with flour. The soil is here very stony, which seems to be indicated by the name of the village. The stones are mostly reddish pebbles, which lie in corroded lumps on and in a light brown clayey soil. At Pierry the country becomes a little more mountainous, and on passing over a considerable chalk hill, the traveller finds near Cramant, and more southerly, near Avize, a *côte* or series of hills, having an easterly exposure and being covered with vines. This *côte* runs from Cramant, Avize, Ojer, and Le Menil up to Vertus, where the vine cultivation terminates. The vineyards of this *côte* are frequently very flat, their inclination often amounting to no more than 3°, and the greatest inclination never being more than 15°, giving a character to the territory which one may call that of an undulating plain. In this part mostly white grapes are grown, and it is stated that the black grapes do not succeed so well. Avize has from 700 to 800 acres of vineyards, among them one with a southern exposure, and an inclination of 4°, called Goutte-d'or. This name is very common in France, and everywhere signifies a place where a good drop of wine is grown.

SOIL OF THE CHAMPAGNE.

The soil which interests us for our present purpose consists mostly of chalk, silica, and clay, of which there are many varieties. Where the chalk is not mixed with silica and clay, it is barren, and the vegetation upon it very limited; but as soon as clay and silica appear, the vegetation becomes richer. As the basis of the geological formation is chalk with pebbles, the fructiferous covering of cultivated ground could only have been formed by the super-addition of alluvial masses; and these we find, singularly enough, upon the high points of the mountains. Much clay has been washed down from them by the agency of the rain, and enormous quantities of it are annually carried on the backs of donkeys or mules, or in waggons and baskets, into the vineyards. One particular kind of clay is termed *cendrière* (ash soil). We observed this black material in the neighbourhood of Verzy and Verzenay, where a trade was apparently being carried on in it, there being depositories at frequent intervals along the road, and establishments where it was mixed with manure and other matters, and formed into a kind of compost. We ascertained that it contained gypsum, iron, clay, and sand.

PREPARATION OF THE SOIL, PLANTING OF VINEYARDS, AND CULTIVATION OF THE VINE.

As the soil is light and easily dug round, the trenches are carried to a depth of about 20 inches. Fallowing is not usual. The plantation of vines is effected by putting blind canes into the ground, called *boutures*. Sometimes young vines of two or three years are taken to effect new plantations. The established vines are every three years sunk nto the ground, and one year's wood only is allowed to project from the ground and to form the new vine. Every vineyard, therefore, is a continuous nursery for the formation of young vines. It is to this circumstance, that no vine which appears above ground has older wood than three years, that the whole of the vineyards of the Champagne owe their extremely juvenile aspect. In the Médoc one sees vines perhaps 150 years old. In the district of Saint Emilion and Sauternes one sees vines which are seventy or eighty years old; but in the Champagne vineyards all that appears above ground is only one, two, or three years old. The method of the Champagne viticulture might, therefore, be called viticulture by constant rejuvenescence. After the fall of the leaves, the vines are so cut that each plant retains two — at the utmost three—stumps or branches, which carry from two to four eyes each. To each such stump is placed a stick, which is about two and a half or three feet high above the ground. If the vines are kept in lines, those lines run in only one direction; but very frequently the vines are not kept in lines in any direction. In one direction they stand close against each other, so that it is impossible to pass through them. In another direction, however, a sometimes straight, sometimes very irregular passage for the work-people is left.

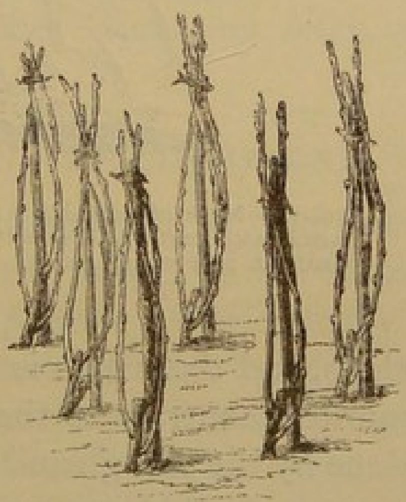


FIG. 70.—View of vines in the vine yards of the Ardennes, where provining is common.

In spring, before the eyes begin to push, the canes are tied to the sticks. The new shoots are tied again to the sticks shortly before blossoming time, and broken off at about half the height of the stick; and the vine is never under any circumstances allowed to grow as high as the stick. All double and lateral shoots, and branches which have no blossoms, are broken off, whereby the sap is compelled to direct itself mainly upon the blossoms.

The soil of the vineyards is treated three times a year, and that mostly with a hoe with two prongs. It is kept very

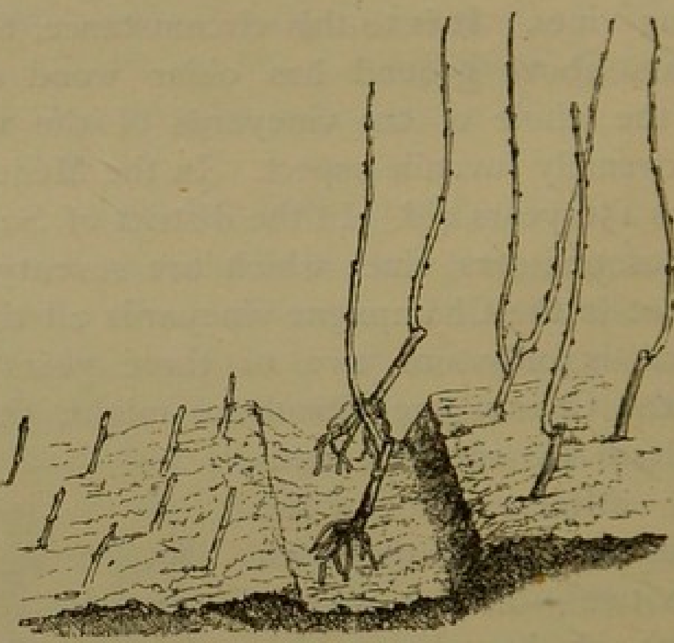


FIG. 71.—Mode of provining in the Champagne. In the trench in the middle are seen vines with partially exposed roots, ready for being sunk. On the left vines project from the re-arranged ground.

clean, and the whole is done by manual labour, thus forming a marked contrast to the Gironde, where the principal labour is done by the plough and animals. The manuring is effected by means of stable manure and compost and the clay already mentioned. Everything is carried to and from the vineyards on the backs of donkeys; and these donkeys and their drivers give to the landscape at all active times a most animated appearance. Each donkey carries two panniers or side-baskets, which contain the manure or the compost or the sticks, and take home the green leaves and branches of the vines which have been cut off, and upon which the donkeys and the other few animals which are kept in these parts are to some extent obliged to live. These baskets also carry home the vintage in a manner which we shall take an opportunity hereafter to describe. The vine-dressers in the Champagne receive from 1*s.* 6*d.* to 2*s.* besides their food, some brandy, and two bottles of wine per day. The work-people do not go home at noon, but only in the evening. The cultivation of an acre of vineyard costs from 160 to 240 francs.

VALUE OF THE VINEYARDS.

At Verzy, an acre of vineyard costs from 4,000 to 10,000 francs; at Ay, 6,000 francs. In better situations, many an acre has been sold at the price of 32,000 francs, which is about 1,300*l.* sterling. Throughout the Champagne prices are very high, because of the great subdivision of the soil, which allows as many as 27,000 proprietors to participate in the benefit of its cultivation by manual labour. At Epernay, Pierry, and Haut Villers, the acre frequently costs from 12,000 to 16,000 francs. At Avize the average price is 4,000 francs, and the better situations fetch up to 8,000 francs.

VARIETIES OF VINES GROWN IN THE CHAMPAGNE.

The dominating vine in the Champagne is the black grape called *plant doré*, which is the same as the black Burgundy, there called *noirien* or *pineau*. The pineau is sometimes distinguished from the noirien and called *gros plant doré*. Both varieties have similar leaves, the upper sides of which are shiny, and have five lobes. But the leaves of the small variety are deeper cut; and its grapes are more dense and rounded off, while those of the pineau are somewhat less cramped. They always show a few green unripe berries among the black ones, while the true plant, *doré*, becomes entirely black. The pineau is also more fructiferous, and gives strong large grapes. This latter sort is found more commonly in the neighbourhood of Verzy. Near Epernay, Haut Villers, and Ay, the plant *doré* is the general vine. We have not been able to determine whether these admitted varieties are true varieties or not. We have seen the plant *doré* at Pierry with such thick berries, and so glistening and black, that it seemed to be a very different vine from the one at Verzy, and yet it was the same. Those who have an opportunity of travelling in various wine-countries and observing how the black Burgundy grape changes its character according to situation, soil, or climate, will be inclined to believe that there is only one black Burgundy, and that its development into pineau or *plant doré* is the effect of accidental circumstances. Next to these black grapes, which yield the best white champagne, there is grown, in the neighbourhood of Epernay, the *meunier* or miller. This gives a wine which is of inferior quality, and does not keep so well; but it bears more than the *plant doré*. When we visited the Champagne in the year 1867, we found that the pineau everywhere had suffered greatly at various periods of the year, and yielded the most indifferent harvests; while the white Burgundy grapes, or white Champagne vines, which stood mixed with the very same pineaus which had suffered, were full of healthy, large, and tolerably sweet grapes. Thus, to the cultivator of vineyards the white Champagne grape is a kind of assurance in bad years. The pineau failing, the white Champagne will at least give him his house drink. This white Champagne grape is called *gros blanc* and *petit blanc*, and also "the white of good nature." If we have called it the Champagne grape, it is because people in the Champagne call it so. It is not a particular species, but is identical with the white Burgundy grape, from which, among others, the wine of Chablis is made. It is reckoned that one-third of the whole vines in the Champagne are of this white kind. It dominates in the upper part of the Champagne, near Avize, Vertus, and Cramant, as we have already seen. In the lower part of the Champagne, from Ay to Rheims, the heights are planted with this vine. The majority of the old vineyards are yet planted half with white, and half with black grapes—a mixture which was formerly supposed to be the most suitable to produce great *mousse* in the wine. At the present time, however, the champagne makers prefer to keep the varieties separate, and to mix the young wine from white grapes with that from black grapes only in spring, after the nature of their separate fermentations is fully known. Here and there a little *gamais* is met with, which, as is well known, is the dominant set of the Mâconnais; but this gives a sour wine which is not suitable for the production of champagne. Another white grape, which occurs here and there, is the *marmot vert*, identical with the *elbling* of the Moselle and the *goix d'Orléans.* A variety, moreover, is also met with which the Germans call "Ruländer," and which is nothing but a black Burgundy which has become half white, and hence is called smoked. Of the German varieties, the Riessling, Traminer, Sylvaner, and Austrians, not a single plant can be discovered throughout the Champagne.

On the whole, then, the character of the effervescent Champagne wines is derived mainly from the black Burgundy grape,—the small and large varieties, with which in good years is mixed a certain quantity of white Burgundy. The still champagnes are made—the red varieties from the black Burgundy only, and the white variety (for example, the excellent white still Verzenay) from the white Burgundy only.

THE VINTAGE IN THE CHAMPAGNE.

As the greater part of the grapes which grow in the Champagne are used for the production of red wine, and only a small proportion for the production of effervescent wine, and as the processes required for these particular products differ from the beginning, the vintage of course has to be arranged in accordance with the product which it is desired to have. Of the 700,000 hectolitres of wine produced annually in the department of the Marne,—a quantity which calculated by bottles would amount to eighty millions,—only about 180,000 hectolitres, or twenty-two millions of bottles, are transformed into effervescent wine. That is a little more than one-fourth of the whole production. The rest is transformed to a small extent into white, but for the most part into red, wine. We intend to treat in this place mainly of the production of effervescent wine, inasmuch as the production of red wine is identical in many respects with the method employed in Burgundy, and therefore requires no particular description. There is no vintage ban in the Champagne. Every proprietor may go to his vineyard when he pleases, and cut off his grapes in whatever manner he pleases. The proprietors either take off the grapes themselves, press them, and sell the wine in December or January; or they sell the grapes as they are on the vines, which is called selling the harvest. This is done either according to an estimate of the quantity per acre, or the grapes are measured after having been cut, and the agreed sum is paid for the grapes delivered. It requires a very intimate knowledge of the proportion of grapes which is necessary to produce a given quantity of wine if one intends to buy grapes by measure, and not to buy must or fermented wine. Thus, in the year 1867 the grapes were so stalky and loose, and the solid matter in the berries was so prevalent, that it was reckoned that from six to seven hectolitres would be required to make one hectolitre of wine, while ordinarily, five or four and a half would be sufficient to produce that quantity. The grapes are sold under all circumstances by the hectolitre, and are, in measuring, heaped up pyramidally above the brim. The grapes being well ripe, and the weather sufficiently favourable, the proprietors begin the vintage. As soon as this becomes known a great many persons of both sexes flock from the neighbouring country to the Champagne, and offer their services for the vintage. Some bring small baskets into which to put the grapes. Others bring donkeys and mules with side-baskets for the purpose of carrying the grapes to the villages. These persons generally assemble in the market-place, or a large yard or other meeting-place, early in the morning—before daybreak—and the proprietors send their agents there to hire them. The wages of course depend upon the demand. In fine weather from 1½ francs to 2 francs will have to be paid, and the persons will have to be kept in food, and sometimes lodged. In bad weather, when there is no demand, they have about 1 franc for the day's pay. Labour is here treated more mercilessly than we have ever seen it treated anywhere else. In return for this treatment the labour revenges itself by striking and putting up for higher wages when the circumstances are favourable. A man with a donkey may receive 3 francs per day; but if the harvest be plentiful and few donkeys are at hand, from 5 to 6 francs per day will have to be paid. This trading begins afresh every morning during the whole time of the vintage, for every contract of labour is available only for one day, and when the sun goes down every one is free to turn whereever he pleases. The labourers having received their wages go to the public-house and mostly are merry. Afterwards they congregate in barns or rooms littered with straw, and sleep for the night. The proprietor, or his vigneron or agent, having engaged his troop of workmen, conducts them immediately to his own yard, provides them with bread and brandy, and takes them at break of day to the vineyard. It is preferred to cut the grapes early in the morning, even though they should be yet a little wet, because it is necessary to press them while they are cool, to prevent the incipient fermentation from extracting any colouring matter from the husk; for although made from black grapes, champagne is the more valuable the more colourless it is. As the cutters proceed through the vineyard, cutting down everything that is ripe, and leaving only that which is absolutely useless, their baskets are, when full, carried to the roadside. Here the cleaners sit. Each basket as it arrives is emptied upon a large tray, and each grape is now examined. All unripe, rotten, half-dried, worm-eaten, or otherwise injured or unsound berries are cut out by means of scissors, and only the perfect grapes or parts of grapes are put into the principal panniers. All imperfect grapes go into the refuse pannier. The moment that two panniers are full they are loaded on the donkey's back and carried home. The animation of a harvest-day in the Champagne can hardly be imagined. Throughout all the green undulating vineyards, hundreds and thousands of people are dispersed ; all the roads are lined with the cleaners and the heaps of grapes on trays and in panniers. Everywhere donkeys stand to wait for new loads, or go in long strings along the narrow paths or the driving roads. So peculiar is this scene to the Champagne, that we have never observed anything like it in any other of the wine-growing countries which we have visited. The donkey is the symbol of the vintage in the Champagne, as the great oxen are the symbol of viticulture in the Médoc. Nowhere else have we seen grapes carried home in baskets. The grapes of the Médoc, for example, would lose half their juice if they were so carried, as they go to pieces with their own pressure. In our visits to the Champagne during harvest time, we were much struck with the good-nature and hospitality of the population. Of the hundreds and hundreds we met on the road carrying home their produce, many would speak to us or answer to our greeting, or would stop and invite us to taste of their grapes—an offer which had not always the object of effecting a sale. The value of a hectolitre of grapes in bad years is 5 francs,—in middling years, such as that of 1867, 10 francs,—and in very good years rises to from 12 to 15 francs. The sale having been somehow concluded, the grapes in the panniers are taken to the press.

PRESSING, FERMENTATION, CELLARING, AND FINING OF THE WINE.

The presses in the Champagne are enormously strong machines. The iron screws, of which there are two to each press, of the size of a strong man's leg, are worked by means of a toothed wheel, which is itself worked by a large upright wheel, to which four or five men can apply their strength. This great strength of the pressing apparatus is necessary, because the grapes do not undergo any previous disintegration by treading with the feet, or by crushing with rollers, or by such other means as are adopted in other parts. The entire grapes, as they are emptied from the panniers, are thrown on the press, and the press is the only agent that extracts the wine. Amongst the qualities of must which run from the press, the first is the best. This is called the "first drop." In middling years this first drop is taken to make the best qualities of wine. The press is adjusted three or four times in this way: the cake of grapes is cut off at the sides, and the cut-off parts are thrown upon the middle, the top of the press is replaced, and force is again applied. By this means all parts of the cake of grapes are gradually subjected to an equal amount of pressure. The fourth drawing is generally a harsh wine, and can only in good years be mixed with the first three drawings. The management of these details is different with various manufacturers, and depends upon the qualities of the grapes they have, upon the nature of the wine they wish to produce, and upon their own particular fancy. Forty baskets of grapes are generally put upon the press at one and the same time, and yield ten pieces of wine. The whole pressing of one quantity has to be finished in two hours, for if it takes a longer time the must will become coloured. The must obtained by the three first pressings (called *serres*) is put into a large vat standing by the side of the press, each vat taking on an average not less than ten pieces. In these vats (called *cuves*) the must is allowed to stand at rest from six to twelve, or, if the temperature be cool, eighteen hours. During this time it throws up a froth on the top, and deposits a mucous matter at the bottom. From both of these impurities it is entirely freed, and drawn immediately into small barrels of two hectolitres each, there to ferment. It is this first process of purification which is so important in the production of champagne. By these means matters are at once removed which are insoluble in the watery must, but would become soluble in an alcoholic liquid, and which would certainly change its taste, if not spoil it. Moreover, the amount of nitrogenous matter is thereby reduced to a minimum, and fermentation is consequently limited, so that there is a possibility of a small quantity of sugar escaping the effect of the first fermentation, and remaining in the young wine to yield, by a second fermentation in the bottle, the effervescence which is desired. This clearing of the must is also frequently effected by filtration, particularly in hot weather. The froth from the top is removed by decantation. If the weather be hot, and neither of those processes appears safe, it may be necessary to put the fresh must into large casks which have been well filled with sulphurous fumes, in order to stay the fermentation for a sufficient length of time to allow of the clearing of the fluid; but the simpler way is the more common, and the artificial means have only rarely to be applied. The residue which remains in the press, after the wine has been drawn off, is generally used for the production of red wine, the must from white grapes being thrown upon the cake from the black grapes, and allowed to ferment with it in large vats. This red wine is used only by the people in the Champagne itself. It possesses no exporting qualities, and is too low to be transported far even in France itself.

The red wine, when fully fermented, is drawn, and the murk is put upon the press. According to the greed of the proprietor, he spends more or less trouble upon the pressing. At last there remains nothing but a hard cake of stalks, husks, and kernels (*marc*), which is bought by distillers, who distil therefrom what little brandy may remain in them. Sometimes a third wine is made out of them. They are put into the *cuves;* water is poured upon them, and allowed to stand over them from eight to fourteen days; and ultimately a dilute light red liquid is obtained, which the people call *piquette.* Of such *piquette* the whole population drink *ad libitum.* When the must has been put into the barrels, they are carried, either in a fermenting state or when the first fermentation is just over, to the cellars of the champagne manufacturers, or they go into the cellars of the proprietors, supposing them not to be manufacturers. Many manufacturers have these cellars immediately by the side of their press-houses. The barrels are laid in rows, and fermentation is allowed to proceed. In carefully-conducted establishments, the first fermentation is so effected that the barrels are filled to the bung, in order to give to the wine an opportunity of purifying itself by casting out the upward yeast. All these operations of ridding the wine of the nitrogenous matters tend to finish it earlier and to secure its perfect clearness. Fermentation over, the wine is allowed to lie quiet until the weather has become quite cold, generally until the beginning or middle of December. It is then mostly clear, and is drawn from the lees. Now again a period arrives at which commerce becomes enlivened, for the wine has now declared itself to a certain extent as to its quality, and purchases can be made with more safety, but of course of a less speculative kind, and at higher prices. Those who had bought wine during the vintage, and left it in the cellars of the proprietors, now carry it away to their own champagne-making establishments. It is now that the champagne-making houses send their agents about in order to acquire those particular wines of which they stand in need for mixing with the qualities which they may have themselves produced. This mixing is one of the most important operations in the production of champagne. Every manufacturer is, of course, obliged to produce the varieties which the public demand. The public demand Sillery or Epernay—others Ay; this merchant wants Mareuil—the other Dizy; and there is hardly a name of any notoriety that has not its particular admirers. The object of all champagne houses is now to produce, by the art of mixing, wines which shall be as similar as possible to those of which they are to bear the names. When these necessary ingredients have been brought together, they are mixed by vatting, and then drawn off again into the barrels for further treatment.

The next step is the fining of the wine. This is done by means of isinglass. The isinglass is beaten with a hammer and placed in a vessel, and wine is poured over it. After twenty-four hours it has swelled to a large jelly, and it is quite transparent. The whole mass is then kneaded with the hands until there are no more resisting particles in it. Now, gradually, as much wine is added as is necessary to form a semi-fluid paste. It is then allowed to stand for twenty-four hours more, when it has again formed a firm jelly. This adding of wine, and kneading with the hands, is continued every twenty-four hours until the isinglass does not swell any more, or, as it is technically expressed, "ceases to grow." The fining is now ready. It is passed through a tammy, and the necessary quantity of it is then put into each barrel and mixed with the wine by strong agitation. It is generally observed to make the wine clear in from twelve to fourteen hours. 100 pièces, or little barrels, require a pound of isinglass, provided the wine was pretty clear when it was put into the barrels; but in case the wine was thick, each barrel requires a quarter of an ounce of isinglass, which is about double the quantity first mentioned. Throughout the whole Champagne these operations of fining are effected in the small barrels. The reason for this is undoubtedly the facility with which the cold can penetrate these barrels, for it is essential that, at the time of the drawing and fining, the wine should be as cold as possible, and should have been cold for some time in order to completely interrupt all fermentation, and thereby render the wine as bright as possible. The cold in these cellars may be 5° below freezing-point, but not lower, inasmuch as the wine would then begin to freeze. The word cellar or *cellier* in the Champagne therefore indicates a kind of building which in the Médoc is called *chais;* that is, a shed above ground, with doors and small windows, and a ceiling constructed entirely of wood, and which therefore is only capable of keeping out the main part of the cold in winter, and the principal heat in the summer, but still offers great fluctuations of temperature. After the fining has been applied to the wine, the latter is allowed to rest for a week or a fortnight, and then tested as to its clearness. If it is not sufficiently bright, it is allowed to remain another fortnight. If a month's rest has not made it clear, it has to be again drawn off the lees and fined a second time. During these finings and drawings much sulphur vapour is used for the purpose of making the wine as pale as possible.

THE DRAWING INTO BOTTLES ("TIRAGE").

The manufacturer provides himself with bottles during the summer, and has them sent from the glass manufactory in large waggon loads. According to the size of the manufacturing house, from 50,000 to 300,000 bottles may be brought in at a time. After delivery the bottles are tested as to strength. This test consists simply of an experienced person striking two bottles with their sides against each other; and from the sound which they cause he professes to be able to tell the size of the glass and its temper. Those bottles which are not perfectly annealed break at once by the concussion; those which have blisters and galls are rejected. The bottles are not subjected to any physical test to ascertain their resistance to internal pressure. The bottles which are not of good shape are sold to the country people at a reduced price, and it is partly owing to this fact that all the wine which one gets throughout the Champagne, in the small public-houses and so forth, or sees among the small vignerons, is contained in the ordinary champagne bottles. It is sometimes necessary to reject 10 per cent. of all the bottles sent. Those which are approved are now washed with water, the internal rubbing being effected by a revolving brush, which is turned by means of a fly-wheel set in motion by the foot. They are then allowed to stand for some time inverted, in order that all the water may drain out. They are then rinsed with spirit of wine, closed with an old cork, and kept thus ready for use. If the spirit were not used they would possibly become mouldy inside, and communicate a taste to the wine. If they were not stoppered, dust would enter and become inconvenient. On each bottle that enters his yard, the champagne manufacturer pays seven sous, or a little more than three pence, to the State; of all bottles which break at the proof, or subsequently during the fermentation of the champagne, he preserves the neck, and when he pays his next tax he exhibits these characteristic pieces of broken bottles to the tax-gatherer, who thereupon makes an allowance for such broken bottles, and immediately has these fragments entirely destroyed. The hundred bottles cost at the glass manufacturer's 28 francs. The wines which have been prepared as we have above described, mixed, and sorted, are drawn into bottles without any further addition, the bottles being filled to a height of about two inches from the top of the neck. In this respect the manufacture of champagne differs from that of sparkling hock and moselle. In the manufacture of the latter, young wine, to the extent of one-half, is mostly mixed with old wine; and as the Rhenish wines after their fermentation and ageing no longer contain any sugar, it is necessary to add an amount of sugar, so that the whole of the sugar contained in the wine to be fermented is 2 per cent. This presence of 2 per cent. of sugar the manufacturer of champagne mostly secures by means of mixing young wines only. The filled bottles pass now into the atelier, and there through the hands of several workmen. The first of them corks the bottle, the second ties the cork down with string; and again a third ties it with wire. One man hands the bottles to be corked, and another man takes them away, and consequently the atelier consists of five men. It would be difficult to describe the details of the corking machine. Suffice it to say that it consists mainly of two parts, one of which compresses the cork laterally, and the other sends it to the extent of one-half into the neck of the bottle. The corking machine is the better, the more accurately and straightly it fits the cork into the opening. It is very singular that this corking is generally effected much better in the manufactories of effervescent hock and moselle than in the great majority of the manufactories of champagne. This work is effected with such celerity that an atelier of five workmen may bottle and cork from twelve hundred to fifteen hundred bottles daily, or with such rapidity that within one minute two bottles pass through all the hands. As the large houses every year fill several hundred thousand bottles, one can easily see that each of them has to employ several ateliers for about a month in order to obtain their supply. The corks have a very high price, which has now risen to 80, 90, or 100 francs the thousand. It is not advisable for the champagne merchant to save in the article of corks. They are cylindric, two inches long, and one inch in diameter. Few persons have any conception of the compressibility of cork until they have seen it used in the champagne manufactory. As soon as the bottles are filled they are carried into the cellars or caves, and there put up in piles of from 20 feet to 50 feet in length, and 4 feet to 5 feet in height. As they are put up two to four deep, a pile has a breadth of from 3 feet to 4 feet. They are held together by thin wooden laths. The construction of such a pile is as firm as if it was held together with iron bands, and yet any bottle of the outer rows may be taken out from any part and put back without moving the rest of the bottles. The taking out of bottles here and there is necessary for the purpose of examining whether the fermentation has produced a sufficient amount of effervescence. As the temperature of March passes into that of summer, the temperature of these cellars where the bottles are kept of course also rises, and the wine contained in the bottles gradually begins to ferment. As fermentation proceeds the wine gets turbid. It shows when shaken that it is effervescent, and it increases in bulk. Owing to this increase, the empty space which was left in the bottle gradually disappears, and now begins the critical time in the process. Many bottles burst owing to the pressure of the gas simply. Of those bottles in which the air space disappears, most break. Other bottles begin to leak, and a vast amount of wine is lost. It is now time for the manufacturer to consider whether he will uncork his bottles, and thereby go to some expense for work and corks, or whether he will mitigate the fermentation by taking the bottles into a cooler cave, or let the bottles take their chance where they are. When the breakage or *casse* does not exceed 8 per cent. by August, no particular measures are taken. If the casse amounts to 15 per cent., measures are mostly adopted; and if it amounts to 20 per cent., the wine must be opened. Bottles where such an amount of *casse* has taken place have to be handled with great care, inasmuch as they may burst in the hands of the workmen and injure them severely. Careful proprietors therefore cause their workmen to wear masks of wire and gloves during the occupation of opening. Towards the months of September or October, when the temperature falls again, the wine comes to rest, and the breakage almost entirely ceases. In our visits to some of the large establishments we found that the reports from the explosion of bottles at the end of the summer were yet unceasing. There was a constant succession of sounds, as if from the discharge of small air-guns or pistols, which trembled through the vaults, succeeded by the sound of falling fragments of glass and flowing liquid. It is very singular that the champagne manufacturers have no instruments by means of which they could observe the amount of pressure which is developed inside the bottles. There have been devised in France, as well as in Germany, most accurate pressure gauges, which, if applied to a dozen bottles in each stack, would constantly inform the manufacturer of the amount of pressure which the average of his bottles undergo; but in our visits to the caves we have nowhere seen any such instrument employed. To our own mind this is a regrettable want of care, which must necessarily increase the price of champagne; for although the whole of the *casse* might not thereby be saved, we are, nevertheless, certain that it could be reduced to a minimum, and need never exceed 5 per cent. We shall have an opportunity of describing these instruments and their uses.

CLEARING OF THE BOTTLES OF YEAST, OR DISGORGING.

When the fermentation is finished, and the breakage has nearly ceased, the stacks of bottles are rummaged. All the broken bottles are removed, the bottles which have leaked are also put aside, and only those which have kept in good condition are re-stacked. They are then allowed to lie at rest until the whole of the yeast has settled on the lower side of the bottle. In that state the wine remains until it has to be got ready for sale. It is best to leave the wine in that *brute* or unfinished state. The preparations for clearing the wine consist in putting the bottles in rows, with the necks downwards, on long benches which are pierced with holes. A workman now gives to the bottle a skilful turn, and thereby effects the loosening of the deposit of yeast from the side of the bottle, and causes it to sink down upon the cork. This has to be repeated until the whole deposit has been worked down and the wine is quite clear. This operation lasts for some weeks. The wine is then quite clear, and the whole of the deposit rests upon the cork in a layer, in the worst case, of an inch thick, but in the best cases which we have observed the deposit was hardly perceptible.

The bottles are now carefully carried from the cave where they have hitherto been resting, to the atelier, there to undergo the process of disgorging. The disgorger (as the person is called who removes the yeast from the bottle) seizes a bottle, cuts the string and wires, and expels the cork, by exercising a slight lever action with a bent iron or hook. When the cork is three-quarters out, the bottle, which was until now inverted, is turned neck upwards. The cork is discharged with a loud report, and the froth, which immediately rises and is partially projected, carries with it all the yeast and impurity collected in the neck. In order to completely clean the bottle, the disgorger introduces his finger and loosens any matter which may adhere to the glass, and this is also carried out of the bottle by the froth which still rises. Immediately after this operation is completed, he places his thumb upon the mouth of the bottle, and seizes an old cork to stopper it, or places it on a machine provided with fixed corks, which are pressed down on the mouth of the bottle by a strong spring. The bottle thus prepared now passes into the hands of the liqueur man.

LIQUEURING, CORKING, AND FINISHING.

And here we must introduce an episode, and describe *the nature of liqueur*. Champagne prepared in the manner above described is quite dry, that is to say it contains no sugar whatever perceptible to the taste. The operation of liqueuring consists of imparting to it a certain amount of sugar corresponding to the taste of the consumer, and also giving to wine which has not had time to mature a certain finish and flavour by mixing with it a small quantity of good old well-matured and fine-flavoured wine. Hence the champagne merchant who makes fine champagne, provides himself with excellent wines for the purpose of making these liqueurs, and in all these cases the liqueur consists of a mixture of pure cane-sugar and wine only. But the cheap kinds of champagne, not admitting of the introduction of expensive wines, or requiring the addition of alcohol on account of the natural want of that ingredient, are not treated with wine, but with a liqueur consisting of wine, spirit of wine, and sugar. It is impossible to give accurate descriptions of these liqueurs and their chemical composition, because they vary with most manufacturers, and are varied for the purpose of treating each particular lot of champagne. They have to be made stronger or weaker according to the nature of the wine, and the year from which it is derived, and to be added in larger or smaller quantities according to the taste of the consumer. Thus, for England, strong-bodied wines are taken, and little liqueur is added, because in England the dry and semi-dry qualities of champagne are generally preferred. Some qualities of champagne, however, which are imported into England, are made with much liqueur, and the acidity in them is pressed down by mixing to a very small amount, so that they taste more like sugar water than a refreshing wine. For Russia the wine is made similarly sweet and flat. It is made sweetest for Austria and some parts of Germany, where the taste of the people is so far peculiar that they eat sweet compôtes with their roasted meats. In France, champagne is taken with the second part of the dinner, or with the sweets, and there a nice medium of liqueur is commanded. It will thus be seen that the quality of liqueur, and the quantity which is added to each lot of champagne, is decided entirely by the tastes of the various consumers. The liqueur is kept in the atelier in a large can attached to a machine which is under the guidance of the liqueur-man. A certain glass measure, which is in communication with the machine, measures off the amount of liqueur which is to enter into each bottle; but as the bottles are not all equally full, the filling in of the liqueur has to be preceded by an adjustment of the quantity of champagne contained in them, and this again is effected by a most ingenious machine, which allows the champagne in two bottles to be poured backwards and forwards from the one into the other under pressure, so that no portion of the mousse is lost. The moment that this adjustment of the quantity of wine is effected, the measured quantity of liqueur is allowed to flow into the bottle, and the bottle is handed over to the corker. It is again corked in the manner we have before described, and handed to a man who ties down the cork with string, and afterwards to another who binds it down with wire. Thereupon the operation of disgorging and liqueuring is completed. The bottles are now washed externally and allowed to dry. They are next inspected one by one as to their clearness, and, if passed, covered with the usual tinfoil or bronzefoil. The label which the customer desires is attached, and the bottles are wrapped in paper and packed in straw, in boxes, or baskets. To England, champagne is mostly sent in boxes containing three dozen or six dozen bottles. To America, it is usually sent in baskets of 25, 50, 75, or 100 bottles. To Japan and the East it is mostly sent in baskets of one dozen. To many parts of France also champagne is sent in baskets of twenty-five bottles ; but latterly that which was formerly a distinctive demand of each country has changed very much, and cases of one dozen, two dozen, and three dozen, and baskets of all sizes and with all numbers of bottles, are sent, according to the demand, to various parts of the world. The practice of most champagne makers now consists in keeping their wine in an unfinished condition as long as possible, as wine which has been so lying is not so liable to form a second deposit after the first disgorging. It sometimes happens, however, that in spite of all precautions, the wine which has been disgorged or liqueured undergoes a slight second fermentation, and thereby becomes turbid again. It has then, of course, to be disgorged a second time, after the yeast contained in it has previously been deposited upon the cork in the manner already described. If the wine has become turbid without any fermentation, this second disgorging involves the loss of much mousse, and the wine ceases to be *mousseux* and becomes *crêmant.* Formerly, many champagne manufacturers covered the stopper and neck of the bottle with resin or wax. This has mainly the object of protecting the cork against the corrosive action of air and moisture, and against the attacks of worms and beetles. It has been found that the covering of tinfoil is just as efficacious as this waxing, and is far preferable, for on opening a bottle with a waxed cork a great deal of dust is produced, which it is hardly possible to prevent from falling into the champagne as it is poured from the bottle. It is only a silly affectation of some of the Paris dining establishments of the Palais Royal and of the large hotels to continue to have some particularly bad qualities of their champagne waxed with resin, with which small fragments of ground tinsel are mixed.

VARIETIES AND QUALITIES OF CHAMPAGNE, AND QUANTITY AND INCREASE OF ITS PRODUCTION.

Of the bottled wines which are produced in the Champagne, four varieties have to be distinguished.

Of these, the first is *champagne non mousseux.* This is wine which has been fully fermented, fined, drawn into bottles, stoppered in the usual manner of the mousseux wines, tied, and allowed to rest a long time. We shall afterwards see that this is the original method of making wine in Champagne, and that out of this arose the discovery of the mousseux. Of such *non mousseux* we have tasted many qualities, red as well as white, made from black grapes purely, and white grapes purely; and we can affirm that these wines have, if properly matured, striking peculiarities and beauties of taste and flavour.

The second variety is that moderately sparkling wine called *crêmant,* which derives its name from its faculty of forming a slight cream of effervescent bubbles upon its surface when it is poured into the glass.

The third variety is *mousseux.* This wine, on the bottle being opened, projects the cork with an audible report, and begins to rise gently over the margin of the bottle.

The fourth variety is *grand mousseux*, which projects the cork with a loud report, and immediately overflows from the bottle. When poured out, the foam which it produces also rises over the edge of the glass when only a small quantity is poured out.

By careful experiments, conducted with the aid of manometers of various constructions, it has been found that a champagne which contains less than 4 atmospheres, is not any longer saleable as *mousseux* or *grand mousseux*. From 4 to 4½ atmospheres constitute *mousseux*; 4½ to 5 atmospheres *grand mousseux*. From 5½ to 6 atmospheres are the greatest amount of gas ever met with; and if the pressure in any bottle reaches 7 or 8 atmospheres, the bottle usually bursts.

We have yet to distinguish between ordinary wines, fine wines, and cabinet wines; between pale wines, reddish wines, the so-called *œuil de perdrix*, and those rather uncommon red varieties which are sometimes made as articles of curiosity.

The prices of champagne begin at 16*s.* the dozen bottles at the place of manufacture. Some varieties are sold in London, in bond, at 17*s.* a dozen. Much is bought at 22*s.*, and can be sold in London, duty paid, at 28*s.* per dozen. The price of 40*s.* a dozen should give to the consumer a good class of wine; and the highest price he should pay for best should be from 65*s.* to 70*s.* Anything beyond is a fancy price, for which, if it is to be justified, good special grounds ought to be given. Champagne must be kept a few months after liqueuring, in order that the wine and the liqueur may be perfectly amalgamated, and the new flavour become a little developed; but after a year it has reached its perfection, and does not improve after two or three years. It becomes a little etheric, but it loses *mousse*, and becomes *crêmant;* and the dangers from the stoppers leaking increase with the time during which the pressure has been exercised upon them.

The modes of drinking effervescent wines are very different in various countries. Costly champagne is always a luxury, but the cheaper varieties of champagne need not be so considered if properly used. A sound, rather dry wine, in price from 28*s.* to 36*s.* a dozen, is one of the most useful dietetic remedies for impaired digestion which can be imagined. The ordinary idea that champagne cannot be drunk except immediately after the opening of the bottle, and that it becomes flat after standing twenty-four hours, is erroneous. Those who would enjoy a bottle of champagne on three consecutive days, should obtain one of those elegant contrivances in the shape of a pierced corkscrew, with a little tap attached, or a peculiar india-rubber screw stopper. The pierced corkscrew hardly requires any explanation. Once inserted into the cork, the whole of the wine can be withdrawn from the bottle, *ad libitum*, in mouthfuls, or half glasses, or entire glasses, a matter which may be of some importance to invalids desirous of practising economy. The screwed india-rubber stopper is, however, less liable to derangement, and serves almost the same purpose as the other instrument. We can affirm that these appliances fully accomplish their object, but even where it is desired to dispense with them, the cork which has been drawn from the bottle may be so cut with a sharp knife, as to closely fit the neck of the bottle again; and if it be then well tied down, the champagne will remain sparkling for two or three days, even if the bottle be opened once or twice in each day. The glasses from which champagne was originally drunk, were high, narrow, and conical. Latterly, the very reverse shape of glass has become the fashion. We are not able to assign any particular reason for the change. We consider a glass of conical shape, seven inches high, to be the most suitable. These glasses must be hollow to their very base, and the base itself must be rather large and heavy, so that the glass may not be easily upset. In these glasses the sparkling is certainly best observed, and we believe that no little of the attractiveness of champagne rests in its constant sparkling activity. We have also observed wide shallow glasses, which were provided with a hollow stem, so that the sparkling could be perceived proceeding from the bottom of the stem, and rising into and through the shallow part. These glasses are more artful than practical. For the rest, champagne tastes well when drunk from any glass; and we ourselves prefer the tumbler, for ordinary use, to any other vessel.

SHORT HISTORY OF CHAMPAGNE AND ITS MANUFACTURE.

We abstain from giving an historical account of viticulture in the Champagne previous to the discovery of the mousseux; suffice it to say that the Champagne has produced red and white wine ever since the time of the Roman Emperor Probus, A.D. 280, to whom, it is said, the Gate of Mars, still extant at Rheims, was dedicated by his troops. It was not until the end of the seventeenth century that the manufacture of wine was so perfected that the production of mousseux for a trade was thought of. It appears from the historical notes contained in the work of M. Perrier, that there was at the Abbey of Haut Villers a monk of the name of Dom Pérignon, who managed the cellars of the Abbey from the year 1670 to the year 1715. It is related that he had an extremely delicate palate, and that he could so distinguish the grapes as to be able to tell the vineyards from which they came. It is recorded that he died in the year 1715, and the record states that he had administered the affairs of the Abbey to the greatest satisfaction of all his brethren. One of his successors in the administration, Grossard, states that Pérignon was the inventor of effervescent wine. Grossard had in his possession all the documents of the Abbey up to the time of the French Revolution, and he asserts that before Pérignon the art of stoppering bottles with corks was not known, the only stoppers which were used being bundles of hemp dipped in oil, a mode of stoppering which we know to be used in some parts of Italy even nowadays. It is very difficult to decide whether the introduction of corks for the stoppering of bottles led immediately to the discovery of the making of effervescent wines or not. It appears from a little book of the year 1718, which has been examined by M. Perrier, that white effervescent wine had been made already twenty years previously, which would put the making of the first effervescent wine to the year 1695, and such wine was called *pétillant*, "stopper-jumper," or "cork-jumper," and "devil's wine." A great passion for this wine soon arose, but it is reported that in the year 1715 the passion for this new drink had rather diminished, for it appears from this pamphlet of 1718 that its production was then kept secret, and some persons believed, says the writer, that the effervescence was caused by drugs which were put in, and others supposed that the wine had been put in the bottles at a particular phase of the moon, which caused it to become effervescent. The writer maintains that he possessed the true secret of the manufacture, and that that secret had been given to him by Dom Pérignon on his death-bed. If champagne was first made by Pérignon, it was also first made at Haut Villers, for the whole of the activity of Pérignon referred to the produce of that Abbey. The introduction of corks for stoppering bottles of young wine, and tying them down, would, under all circumstances, engender the discovery of mousseux wines. In fact, the production of mousseux wines is not at all an uncommon accident on the Rhine when wine is bottled too early. The wine then begins to ferment at every rise of temperature, and in fact is dry, effervescent wine; but as that article is not desired, such wine has to be poured back into the barrels and to be there tended until it is again free from carbonic acid, clear, and has recovered its flavour. The discovery of effervescent wine we take, therefore, to be the result of a common accident in parts where the producers of wine are, either from the small quantity of their produce or from other reasons, obliged to draw off young wine into bottles; but of course the development of such a crude observation to the high art which is at present called the manufacture of champagne is a matter which could only have been accomplished by a man of genius and perseverance, or by a succession of such men.

The production of champagne has increased enormously in our time. In the year 1835 about five millions of bottles were exported from France. Of these, America took 500,000; England, 700,000; Russia, 500,000; Germany, 500,000; Sweden and Denmark, 200,000; Italy, 100,000, and 600,000 were used in France itself. In the previous year (1834) the bottle-makers delivered to the manufacturers of champagne ten millions of bottles, while in the year 1835 only half that number of bottles was furnished. Ever since that time good years have doubled and trebled the amount of champagne which the merchants have laid in. From the five millions in the year 1835 to an export or a production of twenty-two millions in the year 1866 is an astonishing increase.

SCIENTIFIC CONSIDERATION OF THE CHAMPAGNE PREPARATION PROCESS.

We owe to the activity of Mohr some important developments on this subject, upon which the following considerations are based. They are of course applicable to all kinds of effervescent wines, be they of Germany, France, or America; be they gooseberry, perry, cider, or grape wines.

Phenomena of Absorption of Gas.—All kinds of gases are absorbed by fluids to a certain varying extent; that is to say, they dissolve in the fluids, lose their particular gaseous form, and increase by their own weight that of the fluids. This phenomenon is termed *absorption.* The quantity of gas which will dissolve in a fluid is dependent upon (1) the nature of the fluid; (2) the quality of the gas; (3) the temperature; (4) the pressure, measured by the height of a column of mercury, of which every 760 millimètres (or 28 inches 1 line, old Paris measure, or 29 inches 1 line, old Rhenish measure) are assumed as equal to one atmosphere.

1. The nature of the fluid evidently influences absorption, inasmuch as various fluids dissolve unequal quantities of one and the same gas. Pure absolute alcohol at the temperature of 10° C. absorbs three times as much carbonic acid as pure water of the same temperature, or, in exact figures, one volume of alcohol at temperature 10° C. absorbs 3·514 volumes of carbonic anhydride, of temperature 0° C. and 760 mm. pressure; while water absorbs only 1·1847 volumes of carbonic anhydride under the same conditions. The 3·514 volumes of carbonic acid gas are, as it were, tied up in the alcohol by a certain kind of chemical affinity, which causes them to lose their elasticity or tension. Although 3·514 volumes of the gas are condensed in the alcohol,

yet they do not exercise any pressure upon any vessel in which the alcohol may be confined, and the alcohol can be exposed to the air without losing carbonic gas by effervescence. But the gas is gradually lost by exchange for common air. Other fluids observe a bearing towards carbonic acid gas, which is analogous to alcohol and water; solutions of sugar or salt, oil of turpentine, or sulphuric acid, absorb unequal quantities of one and the same gas, be it carbonic or any other gas.

2. On the other hand, all gases observe a different bearing towards one and the same fluid. Thus water absorbs much more of carbonic acid than of oxygen, nitrogen, or hydrogen, but it absorbs less of carbonic than of sulphurous or hydrochloric acid, of hydrothion or ammonia.

3. The lower the temperature of fluid and gas, the more gas will be absorbed. Warmth prevents absorption or expels the absorbed gas.

4. The quantity of gas absorbed stands in a direct proportion to the pressure exercised upon the fluid. Thus if alcohol at temperature 10° C. and 760 mm. barometer absorbs 3·514 volumes of carbonic acid gas, then the same alcohol, at a pressure of two atmospheres, absorbs twice 3·514, or 7·028 volumes of gas; at the fourfold pressure it absorbs the fourfold volume, and so on. Inversely, when the pressure is removed, the alcohol allows a quantity of the gas to escape: at half an atmosphere the half of 3·514 volumes; at a quarter of an atmosphere only one quarter of 3·514 volumes is retained, while three quarters escape.

The proportion in which a certain gas is absorbed by a certain fluid at a certain temperature and pressure is called the coefficient of absorption, and this is always referred to the unit of volume of the fluid. Thus, when it is said that the coefficient of absorption of carbonic acid in alcohol is 4·3295, this means that one volume of alcohol at 0° C. and 760 mm. pressure absorbs 4·3295 volumes of carbonic acid. The same interpretation has to be put upon the expression that the coefficient of carbonic acid to water is 1·7967, of sulphurous acid to water 68·861, of nitrogen to alcohol 0·12634. For our present purpose the coefficients of carbonic acid to water and alcohol are of the greatest importance. The following table gives these coefficients for temperatures from 0° to 20° C., and the fluid, be it water or alcohol, is always assumed as the unit.

Table showing coefficients of absorption of carbonic acid in water and alcohol at 760 mm. B.

T° C.	Water.	Alcohol.	T° C.	Water.	Alcohol
0	1·7967	4·3295	11	1·1416	3·4461
1	1·7207	4·2368	12	1·1018	3·3807
2	1·6481	4·1466	13	1·0653	3·3178
3	1·5787	4·0589	14	1·0321	3·2573
4	1·5126	3·9736	15	1·0020	3·1993
5	1·4496	3·8908	16	0·9753	3·1438
6	1·3901	3·8105	17	0·9519	3·0908
7	1·3339	3·7327	18	0·9318	3·0402
8	1·2809	3·6573	19	0·9150	2·9920
9	1·2311	3·5844	20	0·9014	2·9465
10	1·1847	3·5140			

It is evident from this table that alcohol under all circumstances absorbs more carbonic acid than water.

By the aid of this table we may calculate the coefficient of absorption of carbonic acid for wine. Let us assume that the latter contains 10 per cent. of alcohol by volume, and 90 per cent. of water by volume, and let the cellar temperature be 12° C. At that temperature one volume of alcohol absorbs, as shown above, 3·3807 volumes of carbonic acid; consequently ten volumes of alcohol absorb 33·807 volumes of carbonic acid. Water at twelve absorbs 1·1018, consequently ninety volumes of water absorbs 90 × 1·1018; = 99·1620 volumes of carbonic acid. Consequently 100 volumes of wine absorb—

By means of the alcohol	33·807 vols.
" " water	99·162 "
Total	132·969 vols.

The coefficient of absorption for wine is therefore represented by 1·32969. Wine thus absorbs nearly $1\frac{1}{3}$ times its volume of carbonic acid. The other ingredients of wine, such as acids, salts, and sugar, are not considered in this calculation; they diminish to some degree the absorptive faculty.

The first fermentation of must cannot be used for the production of effervescent wines. A must of 20 per cent. of sugar would during fermentation develop forty-seven times its volume of carbonic acid, and about 10 per cent. of alcohol. If it were attempted to retain these, they would cause a pressure of 34·3 atmospheres. This would be about ten times the pressure which the boiler of an ordinary high-pressure steam-engine has to undergo. As neither bottle nor cask would stand such a pressure, it would be necessary to let the greater part of the gas escape. But even then the wine could not be used for filling bottles, because it would contain so large an amount of impurities that the deposit in the bottles would become very voluminous, and its removal from them very difficult. For these reasons the wine intended to be made into mousseux is allowed to ferment as usual, and kept until the spring following the vintage, as already described above. It must be clear, but yet contain a trace of yeast and a quantity of albuminous matter in solution as a food for new yeast plants, by which a certain quantity of sugar, either contained or added, may, at a somewhat higher temperature, be fermented, and the necessary quantity of carbonic acid may be formed.

The question now arises, what is the proper quantity of sugar which should be contained in champagne claret at the time of bottling, in order to yield the proper quantity of *mousse?* This question has been answered partly by the analytical observation of perfect specimens of champagne, partly by theoretical considerations.

Experimental Determination of Tension or Pressure in full Champagne Bottles.—This may be effected by various instruments: one, the hollow screw gimlet, is inserted into the cork of the champagne bottle by screwing so that the point enters the gas space of the neck. The gas is prevented from escaping by the tap on the lateral tube, and will of course escape if that tap is opened. After the borer has been cautiously inserted while the bottle is held in a horizontal position, a manometer of glass is attached to the free end of the lateral tube.

The manometer consists of a long tube closed at the end, and filled with air. The lower syphon and part of the bulb are filled with mercury, and the rest of the bulb is filled with water. Before the experiment the mercury stands at the figure 1 marked on the glass, which signifies one atmosphere, or in other words that the enclosed air is pressed by one atmosphere, or the usual pressure of the air. The tube is divided into parts of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{16}$ of its entire length, calculated from the closed end, and the denominators of these fractions are written upon the glass and indicate atmospheres. [For when air is compressed to half its volume, it presses upon the walls of the enclosing vessel with the weight of two atmospheres, at a compression to $\frac{1}{4}$ its force is that of four atmospheres, or, in other words, the pressure exercised is in the inverse proportion as the space which the air occupies. (Mariotte's law.)] The open tube of the manometer is connected with the open tube of the borer by means of a union screw. The tap is now open, and immediately the pressure in the bottle acts upon the manometer and compresses the air contained in it. The end of the mercurial column indicates the pressure. It is not necessary that the scale should be engraved on the glass, if the tube, as is usual, is equally wide in its course; it is only necessary to apply to it a rule divided into any number of small units, millimètres or eighths of an inch, to ascertain its length from the point to the mercury, then to let the pressure act, and measure the length of the column of compressed air, also from the point of the tube coincident with the zero-point of the rule. By dividing the number expressing the length of the non-compressed air with the number expressing the length of the compressed air, the tension of the carbonic acid expressed in atmospheres is obtained. Thus supposing the air-filled part of the tube to have been 451 mm. long before the experiment, and after application of the pressure to have been 82 mm., then the pressure is $\frac{451}{82} =$ $5\frac{1}{2}$ atmospheres.

Schinz's Manometer.[1]—As glass manometers are fragile, and become covered inside with oxyde of mercury, if the gas included is air and not hydrogen, it is desirable to have more durable instruments. Such a one is the manometer of Schinz, now generally used in connection with high-pressure boilers. This consists of a hollow tube of hard wrought brass, elliptic on its section, and bent into the shape of a circle or spiral, which is exposed to the pressure to be measured from within. The pressure of a fluid or gas in an enclosed space is equal upon all parts of the enclosing walls. If a spiral tube of a *circular* section were subjected to pressure from within, it would be enlarged equally according to its elasticity, but would not undergo any change in its curve. But in a tube of oval section there are many more points on which the pressure acts in the direction of the smallest diameter, than points upon which the pressure is exercised in the direction of the largest diameter. The necessary consequence is that the shortest diameter is elongated at the expense of the longest, so that the elliptic shape of the section of the tube approaches more to that of a circle. If such a tube closed at the ends is bent into a ring with the longer diameter at right angles to the plane of the ring, the ends will move outwards and away from the ideal centre if the internal pressure is increased; a spiral tube will open out like a clock-spring during the course of the clock's action. If one end of the tube be fastened immoveably, the free end will show the combined movements of both ends; and if to this free end a hand is applied, which points to a graduated measure at a distance, all movements of the tube can be indicated on an increased scale. The actual indications of such a manometer, or its scale, are determined by connecting it with glass tubes, in which mercury can be raised to any necessary height by means of a pressure-pump of iron. A column of 760 mm. is equal to one atmosphere. The instrument is applicable to cham-

[1] See Dingler's Polytechnic Journal, 1849, vol. cxiii. p. 85.

pagne bottles, and is made by M. Rahskopff, of Coblentz. The hollow screw-borer can be inserted by itself, and the projecting parts of the tap serve as levers, like the handle of a gimlet. After the borer has penetrated the cork, the manometer proper is attached by means of the screw. When the tap is opened, the hand points at once to the figure expressing atmospheres or pounds to the square inch.

It has been ascertained by many experiments that the amount of pressure which is most preferred in champagne or other mousseux is from 4½ to 5 atmospheres. From 5 to 6 atmospheres produce *grande mousse*,[1] and this engenders always a loss of fluid from rapid overflowing. A mousse of less than 4 atmospheres is saleable only as *crêmant*, and if joined with other low qualities, as *tisane;* it cannot be sold as mousseux : at a pressure of from 7 to 8 atmospheres, nearly all bottles burst. By using a manometer the manufacturer of champagne is thus enabled to ascertain exactly the amount of pressure in his bottles. If in every stack of the same filling he keeps a few bottles permanently provided with the manometer, he can at every hour watch the progress of the fermentation. When the pressure approaches 5 atmospheres, and there is a surplus of sugar, the maker can exactly foretell the time at which the pressure will rise to the dangerous height of 6 and 7 atmospheres, and the breakage or *casse* will begin. Without such an instrument the bursting of bottles is the only sign of excessive pressure which the maker possesses. The application of scientific processes is evidently able to protect him from the reverse, and, with due care, perhaps from any loss by breakage, that from faulty bottles and corks alone excepted.

Treatment of Champagne Claret for Mousse.—When the fined champagne wine, called claret, has come to rest during the winter, it hardly ever contains more than ½ per cent. of sugar. This would be insufficient for producing a good mousse, and therefore sugar has to be added. The claret has also to be exposed to a higher temperature,

[1] "Mousse" signifies moss, from the similarity of the shape of the wine-froth to a patch of moss.

as at the temperature of the cellar it would not ferment any further.

The quantity of carbonic acid to be evolved depends upon the quantity of sugar yet contained in, and that to be added to, the claret. The power of absorption depends upon the amount of alcohol already contained and yet to be formed. It is, therefore, necessary that the manufacturer should accurately know the amount of unfermented sugar present in the claret, and the amount of alcohol. Without these data he cannot adjust the quantity of sugar to be added, nor calculate the coefficient of absorption. And without these calculations his manufacture is exposed to serious risks and uncertainties.

Adjustment of Acid and Alcohol in Claret.—The first operation should always be to adjust the quantity of acid and alcohol in the whole of the claret taken into the cellar to a given standard. As all effervescent wines receive a certain quantity of sugar and of liqueur containing no acid, they may contain somewhat more acid than dry still wines. The latter have from 4 to 5 per mille; effervescent sweet wines, on the other hand, bear from 6 to $7\frac{1}{2}$ per mille. The amount of alcohol in the claret should not be above 8 per cent. by weight, because the fermentation of the sugar to be added and the addition of liqueur always increase the alcohol to 9 or 10 per cent., and its amount can easily be raised to any desired quantity, but not diminished. The must from which such claret is to be made should therefore contain barely 7 per mille of acid; if it contains more, it has to be diluted with water according to the method of Gall, and the sugar, if deficient in consequence, has to be made up by addition. Of grape-sugar the must should contain from 16 to 17 per cent., and consequently possess a specific gravity of 1·072 to 1·076. If all must which the manufacturer makes or buys is thus adjusted, he may rely upon his claret being uniform as to acidity and alcohol. If the must has not been adjusted, the claret itself must be analysed as to its acidity and alcoholicity, and sweetness; if acid and alcohol differ from the standard, they have to be adjusted; the quantity of sugar to be added is regulated as follows. We will assume a claret to contain ½ per cent. sugar, and 8 per cent. by weight or 10 per cent. by volume of alcohol; the fluid contents of a champagne bottle we assume at 800 c. c., the empty, or air-space, at 15 c. c., and the sugar is to be adjusted so as to furnish a *mousse* of 5½ atmospheres. A wine of 8 per cent. alcohol b. w. will, after the necessary *mousse* has been produced, have a strength of about 9 per cent. b. w., or say 11 per cent. b. vol., and at a temperature of 12° C. has a coefficient of absorption of 1·35. At a pressure of 5½ atmospheres 800 c. c. absorb therefore $5{\cdot}5 \times 800 \times 1{\cdot}35 = 5{,}940$ c. c. The air-space of 15 c. c. would hold $5{\cdot}5 \times 15 = 82$ c. c., consequently the entire bottle 6,022 c. c. These weigh at 0° C. 11·8 grms. and at a temperature of 12° C. 11·3 grms. Now, whereas 79 grms. carbonic acid are given out by 171 cane-sugar, the 11·3 grms. required to be formed in the bottle presuppose the presence in the claret of 25·4 grms. of cane-sugar (79 : 171 :: 11·3 : 24·4). But as the wine contained already ½ per cent of sugar, or in 800 c. c. 4 grms., the addition of cane-sugar to be made amounts to 20·4 grms. or almost exactly 2½ per cent. Every 100 litres claret would thus require an addition of 2·5 kilogrammes of sugar in order to be capable of producing a *mousse* of 5½ atmospheres.

But even when all these theoretical requirements have been satisfied, it is necessary to observe especially the progress of the fermentation, for it is affected by many external circumstances. Thus the temperature regulates the power of absorption. The bottles assume slowly the higher temperature of the fermentation room, and never show the maximum heat of a locality, in which the temperature varies daily. On the other hand, if the bottles reach a high temperature, the fermentation is quicker, and the absorptive power diminished, consequently there is more danger of bursting. Further, the atmospheric air included in the 15 c. c. air-space, and the nitrogen dissolved in the wine, diminish the faculty of absorption. All these circumstances have to be so guided that the fluctuation in the pressure within the bottles caused by them shall remain within 5 and 6 atmospheres. If wine has been too much fined, and air has not been sufficiently in contact with it, it is liable to lose its power of passing into fermentation. To obviate this mishap, it is well to carefully ventilate the wine, and to add a minute quantity of yeast to the sugared claret, not exceeding a teaspoonful to the hogshead, in order to make sure that a few spores may be present in every bottle.

Changes in the physical Condition of Champagne by disgorging.—We have already described the various operations of clearing, settling, and disgorging the fermenting champagne. The changes in the physical condition of champagne by disgorging are important. The gas-space has lost its tension, and the wine has lost a portion of its carbonic acid by effervescence. When now the liqueur, consisting of wine or brandy, and sugar, is gently poured along the side of the bottle, and the new cork is forcibly inserted, a quantity of gas is again driven into the air-space, sufficient after some time to eject the cork anew with a report. The report on opening the bottle is produced by the gas which is compressed in the air-space. If this space is large, the report is full and deep, but if the space is small, the report is high-pitched, dry, and short. A good report is only produced by a cork which fits equally all round, and does not allow gas to escape on one side before it is ejected entire. If the cork is unilaterally weak, or stands obliquely, it allows the gas to escape with a hissing noise on opening, and no report is produced. This is so objectionable that the manufacturers who value their reputation spare no money to obtain the best corks. The quantity of carbonic acid gas which is necessary to produce the report is not large. Supposing an air-chamber of 15 c. c., and a compression of $5\frac{1}{2}$ atmospheres, then it would contain 82 c. c. carbonic acid. On the discharge of the cork 67 c. c. of the acid escape, and only 15 c. c. remain. Immediately, however, the wine, from which pressure has been removed, begins to evolve carbonic acid in little vesicles. These, on bursting on the surface of the wine, throw small particles of their walls into the air, and form the slight vapour or fog which leaves the orifice of every freshly opened bottle. It might be supposed that champagne, which was under a pressure of $5\frac{1}{2}$ atmospheres, would quickly disengage $4\frac{1}{2}$ times $1\frac{1}{3}$ volume, or six times its volume of carbonic acid, and retain only $1\frac{1}{3}$ volume, or a quantity corresponding to its coefficient of absorption at 760 mm. But this is not the case, for the viscid liquid retains the carbonic acid very long, and disengages it only gradually by what is called sparkling (*pétillement*). During the whole of this time the wine is over-saturated with the acid, as is shown by many physical phenomena. Thus the gas-bubbles rise mainly from projections and uneven portions of the surface of the glass. Almost invisible particles of dust, which can only with difficulty be removed from the narrow pit of the champagne glass, give cause to the prolonged rise of strings of little pearls of gas. Any porous body, such as bread or sponge-cake, produces immediately a lively effervescence, just like that which in a hot fluid over-saturated with vapour is produced by charcoal or tobacco-pipe. When the glass is held lightly in one hand, and the palm of the other is struck gently on the top of it, bubbles are evolved on the entire inner surface of the glass. The glass being depressed suddenly, while the fluid is unable to follow as suddenly, a slight attenuation is produced in the fluid next to the glass, whereby the gas is liberated.

The twice fermented and disgorged champagne has lost nearly all its albuminous ingredients which could serve as food for the yeast of a third fermentation. It has therefore little tendency to ferment again, and the addition of brandy and sugar diminishes this fermentescibility still further. Most champagne therefore, after proper treatment, remains clear and at rest. It should be kept on its side, so that the cork should remain swelled, and not allow gas to escape. From an upright bottle gas is constantly escaping, and this way is sometimes used to allow an excess of gas to escape during violent fermentation. It is also the remedy adopted to prevent beer-bottles from exploding by excess of pressure.

Deinhard's (Coblentz) clarets, 1862 growth, intended to be filled in bottles in 1863, were examined by Mohr. They showed from 6·6 per mille to 8 per mille of acid, and from 8 to 9 per cent. b. w. of alcohol, mostly near 8 per cent.

The cane-sugar, so-called sugar-candy, which is added in the liqueur to disgorged champagne, is after a short time found to be entirely transformed into invert sugar. The specific gravity of champagne is higher than that of water. The alcohol is more than counterbalanced by the sugar.

Quantity of Carbonic Acid Gas evolved from a Bottle of sparkling Moselle (*Mohr*).—The manometer showed 4½ atmospheres, and the gas collected in a gasometer measured 2,475 c.c.; this is a little more than treble the volume of the wine (800 c.c.). The manometer had sunk to 0, when, by shaking the wine, it could be made to rise again to 1 atmosphere, and the gas evolved measured 42 c. c.; shaken a second time, 44 c. c. of carbonic acid were evolved. It is evident that on the mere removal of the pressure the wine allows the greater part of the gas to escape, and shaking subsequently evolves only little gas; this, on passing into the air-space of the bottle, produces a slight tension. The wine, after being poured into a glass, contains carbonic acid to the extent only of its own volume, no matter what may have been the mousse in the bottle. It is therefore an error on the part of the manufacturer to endeavour to give to his wine a mousse of 6 atmospheres. The cork certainly rises high into the air with a loud report, the wine rises from the bottle and from the glasses, and is in part lost, and spilled on the table; but when it is drank, the wine does not contain more carbonic acid than if the wine in the bottle had contained only 2⅓ to 3 atmospheres. The more the wine is agitated by rapid development of overcharged gas, the quicker it becomes flat. The artificial mineral waters show a similar bearing; they become flat much sooner than the natural ones, which, though less charged, are less agitated.

CHAPTER XV.

WINES OF THE VALLEYS OF THE LOIRE AND CHARENTE.—GENERAL CLASSIFICATION OF THE WINES OF FRANCE.

Topography.—Valley of the Loire.—Varieties of vines.—Two kinds of colouring matter in *teinturier*.—Mode of cultivation.—Department of the Charente and Cognac.—Varieties of vines producing the Cognac.—Mode of obtaining Cognac.—Names of the vines cultivated in the different districts of France.—General classification of the wines of France.—Red wines: first, second, third, fourth, and fifth classes.—White wines: first, second, third, fourth, and fifth classes.—Liqueur wines: first, second, and third classes.—List of the second-rate vineyards of France producing good ordinary wines.

VINES OF THE VALLEY OF THE LOIRE.

In the neighbourhood of Orleans there are considerable plantations of vines which extend through an enormous plain towards Blois, and thence towards Angoulême and Poitiers, and further towards the Charente, into the district of Cognac. The vine most common in that district is the miller or *meunier*, easily recognized by its white-dusted leaves. It bears bluish-black grapes of middle size, and is very fertile. Among the vineyards one perceives many which are exclusively covered with the coloured or colouring grape called the dyer or *teinturier*. The grapes of this vine have the peculiarity that their juice is of a dark red colour on pressing. This, as we know, is not the case with the Burgundy noirien. The juice of the teinturier becomes still darker by fermentation with the husks, from which we learn that there are two kinds of colouring matter present in that grape, namely, one soluble in the acid, sugary juice, and another insoluble in the juice, and extracted from the husk only by the alcohol developed during fermentation. The wine made from the dyer grape is of itself very sour, but it is very well suited for colouring white wines, one part being sufficient to impart to seven or eight parts of wine a red colour. Owing to the large quantity of astringent matter, the white wines obtain by this coloration the character of original red wines, and are sold as such, particularly in Paris, they being unsuitable for transport to greater distances or across the seas. The dyer grape is called *gros noir* on account of its thick black colour. In several places its name is *auvernat tint*, and at Cahors, in the Department du Lot, it is called *auxerrois*. Next to the miller and dyer the *auvernat noir* is the most common grape planted in the valley of the Loire. On examination, this turns out to be identical with the black Burgundy grape. The Gamay also occurs; and there are moreover about ten other varieties, which in small numbers enter upon the set.

MODE OF CULTIVATION.

In the neighbourhood of Orleans and the whole district of Blois the vines are cultivated in straight rows from 3 to 4 feet apart. The canes are so cut that they form arches which are tied to stakes of oak-wood. In the neighbourhood of Blois this method becomes changed. At distances of 5 feet in all directions there are planted four vines closely together in a square, and at a distance of a foot from each vine a stake is driven into the ground. A cane of a foot or a foot and a half in length is now tied to the stake, so that the smaller square formed by the vines is now made double the size by the stakes. When the new shoots have grown to their full extent they are tied together at the top in the form of an arch, so that the vineyards look like arched promenades. In the country extending from Blois towards Tours the cultivation again assumes a different character. A low ridge of mountains stretches for about 45 miles along the former wide bed of the Loire. The whole inclination of this ridge towards the Loire is covered with vines, amongst which not a single stake can be perceived. The vines all lie on the ground, covering it in such a manner that neither a path nor a separation of property can be distinguished. From a distance the whole looks like a light green meadow, which is never interrupted by any new plantations or other crops, from which it may be concluded that the vines are never entirely removed and replanted, but are always rejuvenesced by the sinking of canes. The vines here, on close inspection, are found to be frequently very old; and we have seen some which by their size indicated an existence of fifty or a hundred years. This mode of cultivation is very similar to, or identical with, that which is carried on on the

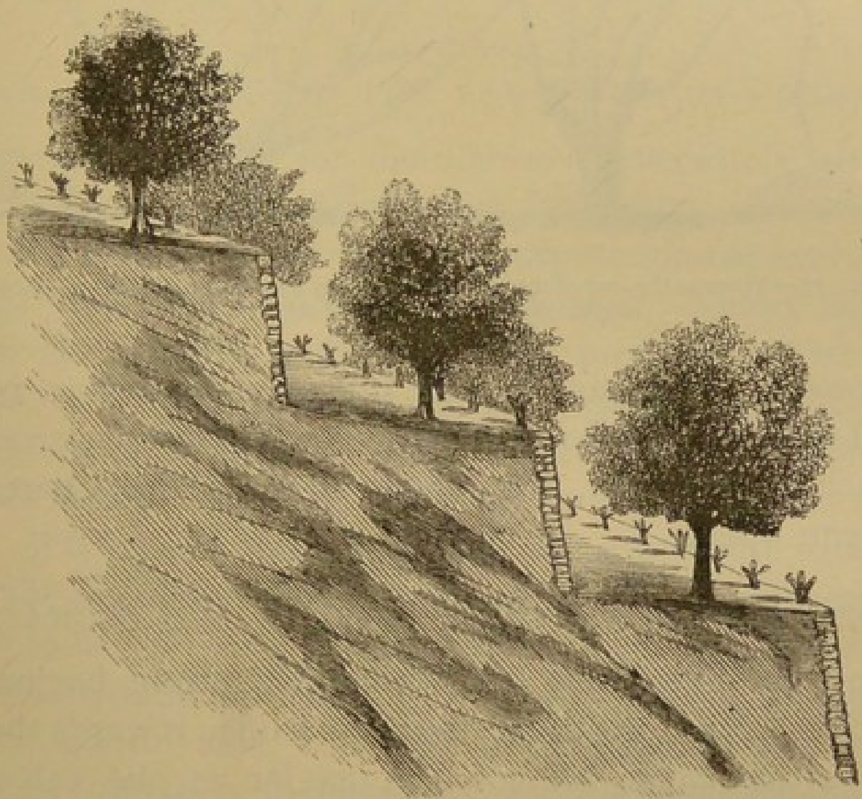


FIG. 72.—View of terraces, planted with olive-trees and vines in front. Department of the Var.

banks of the Nahe in Rhenish Prussia, and there bears the name of "hedge vineyard." From Blois, the whole vine-growing country stretching down to near the Charente is devoid of stakes. In some parts they so cut the vine that it forms by three or four branches a natural basket, the new shoots of which are tied together at the top and thereby support each other. The neighbourhood of Tours is remarkable by the contrast of life which it affords. In some parts of the valley of the Loire men live in excavations of the rock as if they were wild animals. In others, there are luxurious villas and splendid gardens with cypress, pomegranate, fig, orange, and citron trees. The cultivation of the

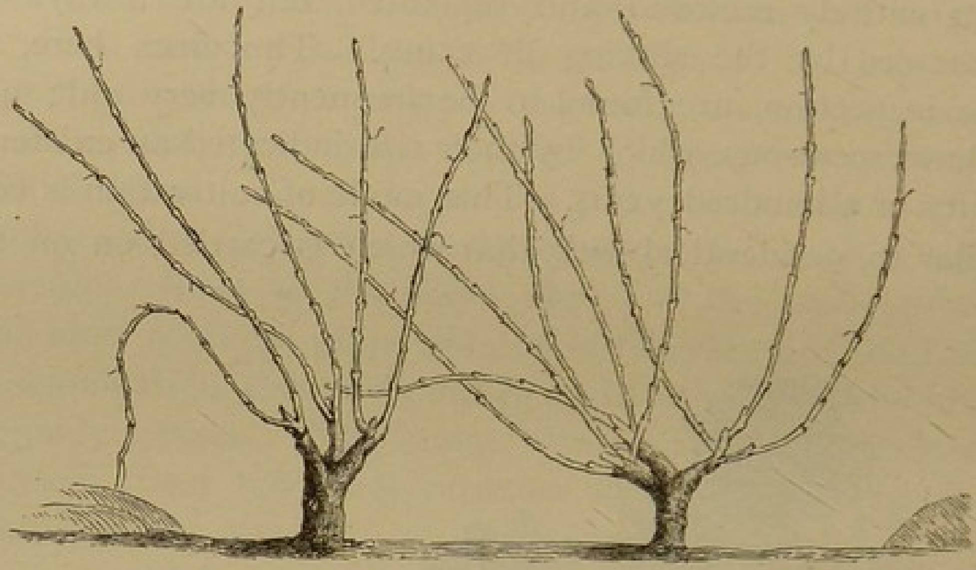


FIG. 73.—Vines at the end of the vegetation period on the olive-bearing terraced heights of the department of the Var.

vine, however, does not rise to any great perfection, and between Tours and Poitiers hardly any viticulture is perceptible. On reaching, however, the department of the Charente, a new scene opens.

DEPARTMENT OF THE CHARENTE AND COGNAC.

About 45 miles west of Poitiers viticulture begins on a large scale. Near the little town of Ruffec towards the river Charente the entire hill-country, as far as one can see, is covered with vines. The plantations extend in the direction of Angoulême and thence towards Cognac, about 15 miles distant from Angoulême.

VARIETIES OF VINES PRODUCING THE EAU-DE-VIE OF COGNAC.

The best cognac is made from white varieties of vines, namely, from the so-called *folle blanche*, the *boillot*, the *blanc doux*, *colombar*, *sauvignon*, and *St. Pierre.* None of the latter of these varieties, however, gives so sweet and well-flavoured a spirit as the *folle blanche.* Its wine, however, is not agreeable, although full of alcohol. Sometimes red grapes are taken for distillation, but their spirit does not possess the soft and agreeable properties which are peculiar to that obtained from white grapes. The varieties cultivated for red wine are *balsac*, *maroquin*, and *dégoûtant.* The latter has a felted leaf. Its grapes are mostly black and shining like coal, and the plant affects the shape of a tree. There are also some of the Burgundy pineaus planted here. Their grapes become very black, owing to the warmer climate, but they do not attain a great age.

MODE OF OBTAINING THE EAU-DE-VIE OF COGNAC.

The wines are used for distillation immediately after the fermentation is over. Distillation, therefore, is carried on during the whole winter.. For this purpose almost every other vineyard proprietor is possessed of a still. Those, however, who do not possess a still sell their product to the larger distillers, or have it distilled by the migrating distillers, who go about from village to village, and distil the spirit out of any one's wine. In spring the process of distillation mostly ceases. The spirit obtained is for the most part colourless, and of the strength called "four degrees of Tessa,"[1] equal to from 59 to 60 vol. per cents. of absolute alcohol. It has a disagreeable, burning, and rough taste, without any flavour, and is, in fact, undrinkable. It is kept in barriques of 200 litres for a period of from three to four years. During that time it ameliorates, becomes sweet and tasty, and extracts from the wood the light brown yellowish colour which it has when sold in trade.

1 This alcoholometer of Tessa is a very irregular instrument, known and used only in the Cognac district. It is said that each of its degrees above four is equal to three volume per cents. of alcohol, so that "five of Tessa" would be about 63 per cent. b. vol., and so on. Calculating the value of the lower degrees at that rate, the zero point of Tessa would be about 47 to 48 per cent. b. vol. of absolute alcohol. We may surmise it to coincide with the strength of *eau-de-vie* as formerly sold in commerce, namely, 49·1 per cent. b. vol. (Compare foot-note on p. 401.)

The disagreeable taste of all freshly distilled alcohol is due to the presence of empyreumatic products, which might be removed from it by means of the process recommended by Doebereiner, namely, filtration through animal charcoal; but this process will also withdraw from brandy the elements from which, in the course of time, the volatile ethers are formed, to which it owes that peculiar flavour for which we praise it—a flavour which, when developed in brandy twenty and forty years old, is almost identical with that of vanille. The quantity of brandy produced in the Charente is 180,000 hectolitres, being the produce of the distillation of 1,400,000 hectolitres of wine, which, together with 300,000 hectolitres drunk in the country and sold as wine, make the 1,700,000 hectolitres of wine which grow on the 112,648 hectares of vineyard in this department. The practical estimate gives the quantity of cognac obtainable as one bottle from six to seven bottles of white wine in good years. In bad years eight to ten bottles are required to give a bottle of cognac. The value of wine, as such, in this part of France is perhaps the smallest of that existing in the world, no more than 8 to 10 francs per 200 litres being paid for white, and 18 to 20 francs for red wine. Yet wine continues to be produced; and this is owing no doubt to the fact that climate and soil do not admit of any other crops. The formation of the land rests everywhere upon a kind of chalk, which covers the soil with fragments in the same manner as in the Bourgogne. The only cultivation which this soil receives is a superficial grubbing and hoeing in spring. The vines are cut once in the spring, and beyond that no operation is effected either upon the soil or the vine. The rest is left to Providence and the sun. The vines here are frequently of the shape of trees, and after a certain number of years their stems are so strong that children can easily mount them. Stakes are neither required nor used.

NAMES OF THE VINES CULTIVATED IN THE DIFFERENT PARTS OF FRANCE.

SOUTH.

Corsica.

Sciacarello.
Montanaccio.
Cargajolo nero.
Vermentino.
Genovese.
Biancolella.
Malvasia.
Creminese.
Moscatello.

Roussillon.

Grenache noir.
Carignane.
Mataro, or Mourvede.
Picpoule noir.
Clairette.
Muscat de Rivesaltes.
Maccabeo.
Malvoisie.

Low Languedoc.

Terret noir.
Mourastel.
Aspiran, or Piran.
Œillade.
Sinsaou.
Picpoule blanc.
Aramon.
Terret-bourret.
Blanquette.
Gallet.
Picpoule gris.
Muscat de Frontignan, rouge et blanc.
Furmint.
Picardin.

Provence.

Catalan.
Tibouren.
Bouteillan.
Pecoui-touar.
Brun-fourca
Téoulier.
Pascal, noir et blanc.
Barbaroux.
Rousselet.
Uni blanc.
Colombaud.
Araignan.
Mayorquin.
Panse.

SOUTH-EAST.

Dauphiné.

Camavèze.
Calitor.
Mollard.
Mollardon.
Plant du Four.
Espagnin.
Roussanne.
Marsanne.
Grosse et Petite Sirrah.

Lyonnais.

Vionnier.
Serine noir.

EAST.

Beaujolais.

Petit Gamai.
Gamai Nicholas.

Mâconnais.

Bons Plants, or Plants de la Dombe.
Gamai picard.
Chardenet.

Higher Burgundy.

Noirien, or Pineau.
Beurot, or Pineau gris.
Gamai.
Giboudot.
Gamai de Montagne.
Pineau blanc.

Lower Burgundy.

Beaunois.
Lombard.
Tresseau.
Romain.
Pineau de Coulange.
Gros et petit Vérot.
Vérot mousseux.
Pineau noir à petits grains.
Sévignés rouge, blanc et vert.
Troyen.

EAST—*continued.*

Franche Comté.

Poulsard.
Trousseau.
Baclan.
Enfariné.
Savagnin noir.
Maldoux.
Gamai blanc, or Melon.
Savagnin jaune.

Lorraine.

Petit noir.
Grosse race noire.
Ericé noir, or Liverdun.
Vert noir.
Gros-Bec.
Aubin blanc, et Aubin vert.
Pétracine.
Vert Plant.

Champagne.

Plant doré.
Plant vert doré.
Épinette.

CENTRE.

Blasois et Orléanais.

Lignage.
Auvernat.

Nivernais.

Blanc fumé.
Sauvignon de Pouilly.
Muscadet, or Chasselas.

Auvergne.

Lyonnais.
Gamai.

WEST.

Touraine.

Arnoison.
Côt rouge.
Malvoisie.
Meunier.
Grolot.
Breton.
Gros et menu Pinot de la Loire.

Aunis & Saintonge.

Folle Blanche
Colombar.
Balzac.

SOUTH-WEST.

Bordelais.

Cabernet-Sauvignon.
Franc Cabernet.
Merlot.
Malbec.
Verdot.
Cruchinet.
Carmenère.
Grosse Vidure.
Vidure Sauvignone.
Sémillon.
Sauvignone.

Périgord.

Fer.
Périgord.
Navarre.

Béarn.

Arrouyat.
Bouchi.
Tannat.
Mansenc, noir et blanc.

High Languedoc.

Bordelais.
Chalosse.
Duras.
Talosse.
Prunelard.

GENERAL CLASSIFICATION OF THE WINES OF FRANCE.

RED WINES.—FIRST CLASS.

The wines composing this class are grown in a limited number of vineyards, the majority of which are so small that it is impossible for their products to equal the demand of the connoisseurs; therefore their price is always very high, especially when they are the produce of a year favourable to the vine. These celebrated vineyards are divided among three provinces, viz. Burgundy, the Bordelais, and the Dauphiné. The wines they produce unite, in exact proportions, all the qualities which constitute perfect wines of their kind, and differ among themselves by a character peculiar to them. The wines of Burgundy are distinguished by the suavity of their taste, their finesse, and spirituous aroma. Those of the Bordelais by a very powerful bouquet, great flavour, strength, without being intoxicating, and a slight characteristic roughness. The wines of the Dauphiné have somewhat the character of those of the Bordelais, much body, and some of the juiciness of the Burgundy wines; they are also very spirituous.

The first growths of Burgundy are—Romanée-Conti, Chambertin, Richebourg, Clos-Vougeot, Romanée de St. Vivant, Tâche, Clos St. Georges, and Corton, in the department of the Côte d'Or.

The Bordelais furnishes this class with, firstly, its four first growths, viz.:—Château Margaux, at Margaux; Château Lafitte, at Pauillac; Château Latour, at St. Lambert; and Château Haut Brion, at Pessac. Secondly, the second growths, which differ very little from the first, such as Rauzan and Lascombe, at Margaux; Léoville and Larose Balguerie, at St. Julien de Reignac; Gorze, at Cantenac; Branne Mouton, at Pauillac, and Pichon Longueville, at St. Lambert—all in the department of the Gironde.

In the Dauphiné, the wines of Méal, Greffieu, and Bessas, in the Hermitage district, department of the Drôme, belong to this class.

RED WINES.—SECOND CLASS.

Most of the wines of this class differ but little from those of the first, and generally replace them in commerce; they are grown in eight different provinces. The wines of the Champagne are light, fine, and delicate; they are very heady, but the exhilaration produced by them does not last long, and they are mostly very wholesome. The wines of the Lyonnais differ from those of the Dauphiné by having a little less body, being lighter and more fiery; those of the Comtat d'Avignon are fiery, fine, and agreeable; those of Béarn full-bodied, spirituous, and astringent. The wine of Roussillon has much colour, strength, and alcohol, but less finesse and bouquet.

Champagne.—Verzy, Verzenay, Mailly, St. Basle, Bouzy, and Clos de St. Thierry, department of the Marne.

Burgundy, Beaujolais.—Vosne, Nuits, Prémeau, Chambolle, Volnay, Pommard, Beaune, Morey, Savigny, Meursault, and the farm Blagny, in the department of the Côte d'Or. The Côte des Olivottes, at Dannemoine; the Côtes Pitoy, des Perrières, and des Préaux, at Tonnerre; Clos de la Chaínette and Clos de Migrenne, at Auxerre, department of the Yonne; Moulin à Vent, Thorins, and Chénas, in the Beaujolais and Mâconnais, departments of Saône et Loire and of the Rhône.

Dauphiné.—The second qualities of the Hermitage wines quoted in the first class.

Lyonnais.—The wines of Côte Rôtie, department of the Rhône.

Bordelais.—The third growths and the best of the fourth growths of Cantenac, Margaux, St. Julien de Reignac, St. Laurent, St. Gemme, Pauillac, and St. Estèphe, department of the Gironde.

Comtat d'Avignon.—Clos de la Nerthe, at Châteauneuf du Pape.

Béarn.—The wines of Jurançon and Gau, department of the Lower Pyrénées.

RED WINES.—THIRD CLASS.

Roussillon.—Banyuls, Cosperon, Port-Vendres, and Collioure, department of the Pyrénées Orientales.

The growths yielded to this class by the above-mentioned provinces produce wines which differ from those named before, only in being less perfect.

Champagne.—The red wines of Haut Villers, Mareuil, Disy, Pierry, Épernay, Taisy, Ludes, Chigny, Rilly, Villers Allerand, and Cumières, department of the Marne ; the best of the Ricey, Balnot sur Laigne, Aviray and Bagneux la Fosse wines, department of the Aube.

Burgundy, Beaujolais.—Gevray, Chassagne, Aloxe, Savigny sous Beaune, Santenay, and Chenôve, department of the Côte d'Or ; several growths of Tonnerre, Dannemoine and Epineuil ; Clairion and Boivin, at Auxerre, department of the Yonne ; Fleury, Chapelle Guinchay, and Romanèche, in the Mâconnais and Beaujolais, departments of the Rhône and Saône et Loire.

Auvergne.—The small hill of Chanturgues, near Clermont Ferrand, department of Puy de Dôme, the wines of which have somewhat the character of those of the Bordelais which belong to this class.

Dauphiné.—Croses, Mercurol, and Gervant, in the department of the Drôme.

Bordelais.—Firstly, the fourth and fifth growths of the communes of Margaux, St. Julien de Reignac, Cantenac, Pauillac, St. Lambert, St. Gemme, St. Estèphe in the Médoc ; the wines of Talance, Mérignac and Léognan, in the district of the Graves. Secondly, the best growths of Ludon, Labarde, Macau, Cussac, la Marque, Sousans, Arcins, Listrac, Moulis, Poujeaux, Aversan, St. Sauveur, Cissac, Verteuil, St. Laurent, St. Seurin de Cadourne, in the Médoc, department of the Gironde.

Lyonnais.—Vérinay, department of the Rhône.

Périgord.—Yields dry, fine, light, and spirituous wines in the best growths of Bergerac, department of the Dordogne.

Gascony proper.—The bodied and spirituous wines of Cape Breton, Messange, and Souston, department of the Landes.

Languedoc.—Chusclan, Tavel, St. Geniez, Lirac, Lédenon, St. Laurent des Arbres, and wines called Cante Perdrix, at Beaucaire, in the department of the Gard; Cornas and St. Joseph, department of the Ardèche; the first being light and fine wines, those of Cornas full-bodied wines, and those of St. Joseph being delicate. All are very spirituous, but have little bouquet.

Comtat d'Avignon.—Châteauneuf du Pape; Côteau-Brûlé, at Sorgues, and the estate St. Sauveur at Aubagne, department of Vaucluse, the wines of which are very soft and agreeable.

Provence.—La Gaude, St. Laurent, Cagnes, St. Paul, Villeneuve, and la Malque, department of the Var.

Béarn.—The second growths of Jurançon and Gan, department of the Lower Pyrénées.

Roussillon.—The second growth of Banyuls, Cosperon, Port Vendres, and Collioure, department of the Eastern Pyrénées, as producing very generous wines, suitable for imparting an agreeable taste, and giving strength and body to weaker wines.

RED WINES.—FOURTH CLASS.

Many of the wines of this class, if well kept, and allowed to grow old in the bottle, will acquire a very agreeable taste, and become comparable to some of the wines of the third class. They are therefore often used as fine wines by that section of society which ordinarily drinks very bad wine, and, wishing to have something better on extraordinary occasions, pays for the dearer wine in proportion to its ordinary beverage.

The vineyards named in the preceding classes mostly produce a proportion of wine, which is so inferior that it must be put into this class. Such wine is generally firmer, more acid and coloured than the superior wine of the same class, which enables the consumer to produce an agreeable beverage by mixing it with a certain quantity of water.

Champagne. — Villedemange, Ecueil, Chamery and St. Thierry, department of the Marne; Aubigny and Montsaujeon, in that of the Haute Marne.

Lorraine.—Bar le Duc, Bussy la Côte, Longeville, Savonnière, Ligny, Naives, Rosières, Behonne, Chardogne, Varnay and Creuë, department of the Meuse; Scy, Jussy, St. Ruffine and Dôle, department of the Moselle, produce very good wines.

Anjou.—Champigny le Sec, department of the Maine et Loire.

Touraine.—Joué, and Clos de St. Nicholas de Bourgueil, department of the Indre et Loire.

Orléanais, Blaisois.—Guignes, St. Jean de Bray, St. Jean le Blanc, St. Denis en Val, la Chapelle, St. Ay, Fourneaux, Meun, Beaule, Beaulette, and Sandillon, department of the Loiret; Côte des Grouets, department of the Loir et Cher.

Bourgogne, Beaujolais.—Mercurey, Givry, Dijon, Monthélie, Meursault, Fixin, Fixe, Brochon St. Martin, Rully, and Monbogre, in the department of the Côte d'Or; Judas, Pied de Rat, Rosoir, Quetard, &c. at Auxerre, several growths of Tonnerre, Irancy, Coulange la Vineuse, Avallon, Vézelay, Givry, Joigny, Pontigny, and some others in the department of the Yonne; Lancié, Brouilly, Odenas, St. Lager, Jullienas, Chiroubles, Morgon, St. Etienne la Varennes, Juillier, Emeringe, and Davayé, in the departments of the Saône et Loire and Rhône.

Franche Comté.—Arsures, Salins, Marnoz, Aigle-Pierre, and Arbois, department of the Jura.

Bresse, Bugey.—Seyssel, department of the Ain.

Auvergne.—Chateldon, and Ris, department of Puy de Dôme.

Forez.—Luppé, Chuynes, Chaveny, St. Michel, St. Pierre de Bœuf, and Boen, department of the Loire.

Dauphiné.—Saillans, Vercheny, Die, Donzère, Roussas, Châteauneuf du Rhône, Alan, Garde Adhémar, Montségur, and Montélimart, department of the Drôme; Porte du Lyon, Revantin, and Seyssuel, department of the Isère.

Lyonnais.—Sainte Foy, les Barolles, Millery, and Galée, department of the Rhône.

Bordelais.—Firstly, those wines of the Médoc, called *ordinaires bourgeois* and the best of those called *petits vins.* Secondly, those of the first growths of the palus de Queyries, Montferrand, and Bassens; of the hills of St. Emilion, Canon, and Fronsac, of the communes of Blanquefort, le Pian, and Arsac, in the Haut Médoc; of St. Germain, Valeyrac, Civrac, St. Bonnet, and St. Christoli, in the Bas Médoc, department of the Gironde.

Périgord.—The cantons of Linde, Beaumont, Cunéges, Domme, and St. Cyprien, department of the Dordogne.

Gascony.—The best growths of Tursan, department of the Landes.

Quercy.—The first vineyards of Cahors, department of Lot.

Languedoc.—Roquemaure, St. Gilles les Boucheries, and Bagnols, department of the Gard; St. Georges d'Orques, Verargues, St. Christol, St. Drézery, St. Geniez, and Castries, department of l'Hérault; Cunac, Caysaguet, St. Juéry, St. Amarans, and Gaillac, department of the Tarn; Leucate, Treilles, Portel, Narbonne, Névian, Villedaigne, Mirepeisset, Argelliers, St. Nazaire, and Ginestas, department of the Aude.

Comtat d'Avignon.—Châteauneuf de Gadagne and Sorgues, department of Vaucluse.

Provence.—Les Mées, department of the Lower Alps; Bandol, Castelet, St. Cyr and Beausset, department of the Var; Séon St. Henri, Séon Ste. André, St. Louis, St. Marthe, Cuques, Château Gombert, St. Gérôme, and Olives, department of the Bouches du Rhône.

Béarn, Navarre.—Moneins, Aubertin, Conchez, Portet, Aydie, Aubous, Diusse, Jadousse, Usseau, St. Jean Pougé, Pontz, and Burosse, department of the Low Pyrénées.

Bigorre.—Madiran, Castelnau de Rivière Basse, St. Laune, Soublecauze, and Lascazères, department of the High Pyrénées.

Roussillon.—Espira de la Gly, Rivesaltes, Salces, Baixas Corneilla de la Rivière, Pézilla and Villeneuve de la Rivière, department of the Eastern Pyrénées.

Isle of Corsica.—The best growths of Ajaccio, Sari, Peri, Vico, Bastia, Pietra Negra, Cap-Corse, Bassanese, Maccaticcia, Calvi, Algajola, Callenzana, Monte Maggiore, Corte, Tallano, Bonifacio, and Porto Vecchio.

RED WINES.—FIFTH CLASS.

All the wines which are inferior to the growths mentioned in the preceding classes, belong to this: but there are so many, and their qualities so various, that in order to distinguish those which deserve preference, they must be divided into two sections, the first of which will contain the second and third qualities of ordinary wines; and the second will comprehend the fourth quality of ordinary wines, and the common wines.

First Section.

The second and third qualities of ordinary wines form the great bulk of the wines in daily use throughout France. They do not acquire the finesse or bouquet of the higher class wines, and taste well when mixed with water.

Picardy.—Pargnan, Craonne, Craonelle, Jumigny, Vassogne, Bellevue, Cussy, Roucy and Laon, department of the Aisne.

Ile de France.—Côte des Célestins, at Mantes sur Seine, and the Clos d'Athis, department of Seine et Oise; Côte des Vallées, at Chartrettes, department of Seine et Marne.

Champagne.—Vertus, Avenay, Champillon, Damery, Monthélon, Mardeuil, Moussy, Vinay, Chaveau, Mancy, Chamery, Pargny, Vanteuil, Reuil, and Fleury la Rivière, department of the Marne; Vaux, Rivière les Fosses, and Prauthoy, department of the Haute Marne; Bouilly, Laine aux Bois, Javernan, Souligny, Bar sur Seine, and Bar sur Aube, department of the Aube.

Lorraine.—Apremont, Loupmont, Woinville, Warneville, Liouville, Vigneules, St. Julien, Champougny, Vaucouleurs, Vignot, Sampigney, St. Mihiel, Dampcevrin, Buxières, Buxerules, Montsec, and Hatton Châtel, department of the Meuse; Thiaucourt, Pagny, Arnaville, Bayonville, Charrey, Essey, Villers sous Pruny, and Wandelainville, department of the

Meurthe; Charmes, Xaronval, and Ubexi, department of the Vosges.

Anjou, Maine.—Dampierre, Varrains, Chacé, St. Cyr, Brezé, Saumur, and Neuillé, department of the Maine et Loire, and Clos des Jasnières, department of the Sarthe.

Touraine.—Chisseaux, Civray, Croix de Bléré, Bléré, Athée, Azay sur Cher, Chenonceaux, Dierre, Epeigné, Franceuil, Verets, St. Cyr sur Loire, St. Avertin, and Balan, department of the Indre et Loire.

Orléanais.—Jargeau, St. Denis de Jargeau, St. Marc, St. Gy, and St. Privé, department of the Loiret.

Blaisois.—Thésée, Monthon sur Cher, Bouré, Montrichard, Chissay, Mareuil, Pouillé, Angé, Faverolle, St. Georges, Lusillé, Meusnes, and Chambon, departments of the Loir et Cher.

Burgundy, Beaujolais.—Montagny, Chenôve, Buxy, St. Vallerin, and Saules, in the arrondissement of Châlon sur Saône; several growths in the department of the Côte d'Or, Cheney, Vaulichère, Tronchoy, Molosme, Cravant, Jussy, Vermanton, Joigny, St. Bris, Arcy sur Cure, and Pourly, department of the Yonne; Chassagne, Villiers, Regnier, Lantignier, Quincié, Marchand, Duret, les Etoux, Cercié, St. Jean Dardières, Pizay, Jasseron, Vadoux, Belleville, Montmélas St. Forlin, Charentay, Charnay, Prissé, Vauxrenard, St. Amour, Chevagny, Chasnes, Laines, and St. Vérand, department of Saône et Loire, and arrondissement of Villefranche, department of the Rhône.

Franche Comté.—Clos du Château, at Ray, department of the Haute Saône; Voiteur, Ménetru, Blandans, Vadans, St. Lothain, Poligny, Gérage, and St. Laurent, department of the Jura; Besançon, Byans, Mouthier, Lombard, Liesle, and Lavans, department of the Doubs.

Bresse, Bugey, pays de Gex.—Seyssel, Champagne, Machurat, Talissieux, Culoz, Anglefort, Groslée, St. Benoît, Virieux, and Cerveyrieux, department of the Ain.

Poitou.—Champigny, St. Georges les Bailleraux, Coutures, Jaulnais, and Dissais, department of the Vienne.

Berry, Nivernais, Bourbonnais.—Chavignol, and Sancerre, department of the Cher; Garenne du Sel, department of the Allier; Pouilly, department of the Nièvre.

Aunis, Angoumois, Saintonge.—Saintes, Chapnières, Font-couverte, Bussac, la Chapelle, St. Romain, Saujon, le Gua, St. Julien de Lescape, Nouillers, and Beauvais sur Matha, department of the Charente Inférieure; St. Saturnin, Asnières, St. Genis, Linars, Moulidard, and the best growths of the other vineyards of the department of the Charente.

Limousin.—The hills of Alassac, Saillac, Donzenac, Varetz, and Syneix, department of the Corrèze.

Auvergne, Velay, Forez.—Mariol, Lachau, Calville, la Chaux, les Martres, Anthezal, Monton, Vic le Comte, Montpeyroux, and Coudes, department of the Puy de Dôme; Renaison, department of the Loire.

Lyonnais.—Irigny, Charly, Curis, Poleymieux, and Couzon, department of the Rhône.

Dauphiné.—St. Chef, St. Savin, Jaillieu, Rui, Les Roches, and Vienne, department of the Isère; the greater part of the produce of Saillans, and of the other vineyards of the department of the Drôme, already quoted in the fourth class.

Bordelais.—The majority of the petits vins of the Médoc, those of Lussac, Puisseguin, Parsac, of the canton of Coutras, and several other communes in the environs of Libourne; the produce of Ambès, and the other vineyards of the Palus de la Garonne, near Bordeaux; that of the hills which stretch from Ambarès to St. Croix du Mont, and the neighbourhood of Bourg sur Mer, department of the Gironde.

Périgord.—Chancelade, and some of the communes of the department of the Dordogne, quoted in the fourth class.

Gascony.—Tursan, Côte de Lényе, and Haute Chalosse, department of the Landes; Verlus and Mazères, department of the Gers.

Agenais.—Thésac, Péricard, and Montflanquin, department of Lot et Garonne.

Quercy.—The wines of second quality of the department of the Lot, and some of its rose-coloured wines.

Languedoc.—Mauve, Limony, Sara, Vion, Aubenas, and l'Argentière, department of the Ardèche; Lacostière, Jonqières, and Pugeault, department of the Gard; Fau, Aussac, Auvillar, St. Loup, Campsas, la Villedieu, and Montbartier, department of Tarn et Garonne; Meilhart, la Roque, Lagrave, Técou, and Rabastens, department of the Tarn; Garrigues, Pérols, Villeveyrac, Bouzigues, Frontignan, and Poussan, department of the Hérault; Villaudric, and Fronton, department of the Haute Garonne; Fitou, Leucate, Treilles, Portet, and Narbonne, department of the Aude.

Comtat d'Avigon.—Morières, Avignon, and Orange, department of Vaucluse.

Provence.—La Cadière, St. Nazaire, Ollioules, Pierrefeu, and Cuers, department of the Var.

Béarn, Navarre. — Lasseuble, la Hourcade, Saut de Navailles, Cucuron, Luc, Lagor, Navarreins, and Sauveterre, department of the Low Pyrénées.

Bigorre.—The second qualities of the growths named in the fourth class, department of the High Pyrénées.

Roussillon.—Torremila, Terrats, Esparron, le Vernet, and many other vineyards of the department of the Pyrénées Orientales.

Ile de Corse.—The secondary growths.

Second Section.

All the growths yielding wines inferior to the third quality of ordinary wines should be comprehended in this class; the best of them are qualified as ordinary wines of the fourth quality, the others are called common wines, and their number and variety would furnish materials for several subdivisions.

Picardy.—Crépy, Brives, Orgeval, Mont Châlons, Vourcienne, Ployard, Arancy, Château Thierry, Treloup, Vailly, and Soupières, department of the Aisne; which are ordinary wines of the fourth quality, the other growths yielding only common wines.

Normandy.—Château d'Illers, Nonancourt, Bueil, Menilles and Portmort, in the department of the Eure, furnish only common wines.

Ile de France, Brie, and part of Gâtinais.—Mons, Andresy, Mantes sur Seine, Septeuil, and Boissy sans Avoir, department of Seine et Oise, produce pretty good ordinary wines; Clermont, Beauvais, Compiègne, and Senlis, department of the Oise; Deuil, Montmorency, Argenteuil, and Sannois, department of Seine et Oise; Grande Paroisse, Fontainebleau, St. Girex, Orly, Courpalay, Meaux, and Lagny, department of Seine et Marne, yield only common wines.

Champagne. — Châtillon, Romery, Vincelles, Cormoyeux, Villers, Œuilly, Vandières, Verneuil, Troissy, the environs of Sézanne, Châlons sur Marne, and Vitry sur Marne, department of the Marne; all the growths of the department of the Ardennes; St. Dizier, department of the Haute Marne; Gyé, Neuville, Landreville, and Villenoxe, department of the Aube, produce some ordinary and many common wines.

Lorraine.—Belleville, les Rochelles, les Allouveaux, Rambercourt, Loicey, Ancerville, &c., department of the Meuse; Toul, Bruley, Dom-Germain, Pannes, Anvezin, Jaulnay, Ecrouves, Lucey, Rambercourt, Boudonville, Côte-Rôtie, Pixerécourt, Roville, Neuviller, Vic, Tinery, and Achain, department of the Meurthe, and Neufchâteau, Épinal and St. Dié, department of the Vosges, produce wines belonging to all the qualities of this section, but the majority will not bear transport.

Bretagne.—Very few red wines are grown in this province, and they are very bad.

Anjou, Maine.—Bazouges, Brouassin, Arthezé, Chapelle d'Aligné, St. Vérand, Cromières, la Flêche, and Gazoufière, department of the Sarthe, yield ordinary wines. The rest of the vineyards produce only common wine.

Touraine.—Chinon, Luynes, Fondettes, Langeais, St. Marc, Amboise, Pocé, St. Ouen, St. Denis, Chargey, Limeray, Mones, Souvigny, and Chargé, department of the Indre et Loire, produce some ordinary wines. The other growths yield common wines.

Orléanais.—Bou, Mardié, Olivet, St. Mesmin, St. Marceau, St. André, Cléry, St. Paterne, Sarang, Gedy, Ingré, Fleury, and Senoy, department of the Loiret, produce different qualities included in this section.

Gâtinais.—The districts of Montargis and of Pithiviers, department of the Loiret, produce small quantities of ordinary wine, and large quantities of common wine.

Blaisois.—Onzain, Mer, and Chaumont, yield ordinary wines. Romarantin, and Vendôme, department of Loir et Cher, produce nothing but common wine.

Burgundy, Beaujolais.—Jambles, St. Jean de Vaux, St. Marc, and several other vineyards of the district of Châlon sur Saône; some in the districts of Semur and Châtillon, department of the Côte d'Or; Pontigny, Vezinnes, Junay, St. Martin, Commissey, Neuvy le Sautour, Villeneuve sur Yonne, St. Julien du Sault, Paron, Véron, and many other growths of the department of the Yonne; Loché, Vinzelles, Hurigny, Sancé, Sénecé, St. Jean de Prêche, St. Gengoux le Royal, Blacé, St. Julien, Sâle, Denicé, Lacenas, Bussière, Domage, St. Sorlin, Azé, Pierreclos, Verzé, Igé, St. Gengoux de Chissey, Clessé Viré, Lezé, Peronne, Cogny, Liergue, Tournus, Lacrost, Grattey, Boyet, Plotte, Ozenay, le Villars, Lugny, Crusille, &c., in the department of Saône et Loire, and the district of Villefranche, department of the Rhône, produce an abundance of ordinary wines of pretty good quality, and very many common wines of various qualities.

Franche Comté.—Ray, Charicy, Navenne, Quincey, Gy, and Champlitte le Château, department of the Haute Saône; Jalleranges, Pouilley des Vignes, Beurre, Châtillon le Duc, Chouzelot, and Pointvillers, department of the Doubs, and some vineyards in the department of the Jura, produce ordinary and common wines.

Bresse, Bugey, pays de Gex. — St. Rambert, Torcieux, Ambérieux, Vaux, Lagnieux, St. Sorlin, Villehols, Lhuis, Montmerle, Thoissey, Montagneux, &c., department of the Ain, yield ordinary, and passable common wines.

Poitou, Saintonge.—Chauvigny, St. Martin la Rivière, Villemort, St. Romain, and Vaux, department of the Vienne; Mont en St. Martin de Sauzaire, Bouillé Loretz, Rochenard, Lafoye-Mongeault, and Airvault, department of Deux Sèvres;

Luçon, Fay Moreau, Loge Fougereuse, and Talmont, department of the Vendée, produce some ordinary wines, and inferior qualities of common wines.

Berry, Nivernais Bourbonnais.—Vasselay, Fussy, and St. Amand, department of the Cher; Valençay, Vic la Moustière, Veuil, Latour du Breuil, Concremières, and St. Hilaire, department of the Indre, produce good wines of most qualities of this section.

Aunis, Angoumois, and part of Saintonge.—Marennes, St. Jean d'Angély, St. Just, la Rochelle, the isle of Oléron, and the isle of Ré, department of the Charente Inférieure; Fouquebrune, Gardes, Blanzac, Vars, Montignac, St. Sernin, Vonthon, Marthon, Mornax, Couronne la Pallue, Roules, Nersac, Chassors, Julienne, and the vineyards of Confolens and Barbezieux, department of the Charente, yield good ordinary wine, and much common wine of bad quality.

Limousin.—Meissac, St. Bazile, Queissac, Nonnars, Puydernac, Beaulieu, Argentat, department of the Corrèze, and all the growths of the department of Haute Vienne, produce more common than ordinary wine.

Auvergne, Velay, Forez.—A large proportion of the vineyards named in the first section of this class, and Néché, Issoire, Cornon, Landet, Orcet, Lesandre, Mezelle, Dallet, Pont du Château, Beaumont, Aubières, &c., department of the Puy de Dôme; St. André d'Apchon, St. Haon le Châtel, and Charlieu, department of the Loire, yield a very large quantity of common wine of various qualities.

Dauphiné, Lyonnais.—Lambin, Crolles, la Terrasse, Grignon, St. Maximin, Murinais, Bessins, Pont en Royans, and St. André, department of the Isère; Étoile, Livron, and St. Paul, department of the Drôme, and all the growths of the department of the Hautes Alpes. The vineyards mentioned in the first section of this class also yield wine belonging to this.

Bordelais.—Many of the petits vins of the Médoc, a still greater number of those of the palus of the Dordogne, of the cantons of Guitres sur l'Isle and Bourg; the inferior wines of the palus of the Garonne, near Bordeaux, of the canton of Carbon Blanc, and of the little hills on the right bank of the Garonne; of Entre-deux-Mers; of St. Macaire and Blaye, department of the Gironde, yield ordinary wines of good quality, and a prodigious quantity of common wines.

Périgord.—Brantôme, Bourdeille, St. Pantaly, St. Orse, Varrins, and some other growths of the department of the Dordogne.

Gascony.—Most of the vineyards in the department of the Landes; Viella, Gouts, Lussan, Ville Comtal, Miélan, Beaumarchais, Plaisance, Vic Fezensac, Valence, and Miradoux, in the department of the Gers.

Agenais.—Buzet, Cassel Moron, Sommensac, La Chapelle, Notre Dame de Pech, Marsac, &c., department of Lot et Garonne.

Quercy.—The tinted wines made in some of the cantons of the department of the Lot.

Rouergue.—Lancedac, Agnac, Marcillac, Gradels, Cruon, and many other growths of the department of the Aveyron, yield some ordinary wines, and some very common wines.

Languedoc.—The growths of the department of the Ardèche, which are included in the first section of this class; Marvejols, Florac, and Villefort, department of the Lozère; Laudun, Langlade, Vauvert, Milhau, Calvisson, Aigues Vives, and Alais, department of the Gard; most of the growths of the departments of Tarn et Garonne; Gaillac and Alby, department of the Tarn; Loupian, Mèze, Agde, Pézénas, Béziers, Lodève, and Montpellier, department of the Hérault; Montesquieu de Volvestre, Cappens, Buzet, and Cugnaux, department of the Haute Garonne; Lagrasse and Alet, department of the Aude, yield ordinary and common wines.

Comtat d'Avignon.—The department of Vaucluse has many vineyards producing common wine.

Provence.—Pierrefeu, Cuers, Solliés la Farlède, Hyères, Lorgues, St. Tropez, Brignoles, &c., department of the Var; Aubagne, Gemenos, Auriol, Cugnes, and many other vineyards of the department of the Bouches du Rhône, as well as nearly all those of the department of the Lower Alps.

Béarn, Navarre.—Those growths of the department of the Low Pyrénées quoted in the first section of this class.

Bigorre.—Bagnères, Argelés, &c., department of the High Pyrénées.

Conserans, Comté de Foix.—Bordes, Campagne, Teilhet, and Engravies, department of the Ariège.

Roussillon.—Prades, department of the Pyrénées Orientales.

Ile de Corse.—Most of its red wines belong to this class.

WHITE WINES.—FIRST CLASS.

Five provinces yield wines of superior quality, viz.:—

Champagne.—The dry wines called Sillery, which are grown at Ludes, Mailly, Verzenay, and Verzy; the soft wines of Ay, Mareuil, Dissy, Pierry, Hautvillers, and the vineyard of Clozet, at Épernay, department of the Marne; they are distinguished for their lightness, delicacy and agreeable taste.

Burgundy.—The celebrated wines of Montrachet, department of the Côte d'Or, unite body and strength with great finesse and bouquet.

Bordelais.—The strong full-flavoured wines of the first growths of Barsac, Preignac, Sauternes, and Bommes, and the dry wines of Villenave d'Ornon, department of the Gironde.

Forez.—The excellent wines of Château Grillet, department of the Loire.

Dauphiné.—The wines of the Hermitage, having great body, strength, and perfume.

WHITE WINES.—SECOND CLASS.

Champagne.—Cramant, Ménil, Avise, Épernay and St. Martin d'Ablois, department of the Marne.

Burgundy.—The vineyards of la Perrière, la Combotte, la Goutte d'Or, la Genevrière and les Charmes, at Meursault, department of the Côte d'Or.

Franche Comté.—Château Châlons, Arbois and Pupillin, department of the Jura, as much for their still as sparkling wines.

Lyonnais.—Condrieu, department of the Rhône.

Bordelais.—The second and third growths of Barsac, Preignac, Sauternes, Bommes, Villenave d'Ornon, and Blanquefort, and the first growths of Langon, Toulenne, St. Pey Langon, Fargues, Pujols, Ste. Croix du Mont, Loupiac, Léognan and Martillac, department of the Gironde.

Agenais.—Clairac and Buzet, department of Lot et Garonne.

Languedoc.—St. Péray, department of the Ardèche, for still and sparkling wines.

Béarn.—Jurançon, Gan, Laroin, St. Fost, Gélos, Roustignon and Mazères, department of the Basses Pyrénées.

WHITE WINES.—THIRD CLASS.

Champagne.—The third qualities of the growths already named, with those of Oger and Grauves, department of the Marne.

Anjou, Maine.—The wines of the Hills of Saumur, called Rotissans, la Perrière, and Clos Morin, and those of the Pailleux. The first qualities of sparkling wines also belong to this class.

Burgundy, Beaujolais.—The farm of Blagny, the wines called the *première cuvée* of Meursault, department of the Côte d'Or; the hills of Vaumorillon, at Junay; the vineyards des Grisées, at Epineuil, and des Olivottes at Dannemoine; those of Clos, Valmure, Vaudésir, Grenouille, Bouguereau, and Mont Milieu, at Chablis, and the best sparkling wines of the Tonnerrois, department of the Yonne; Pouilley and Fuissey, department of the Saône et Loire.

Franche Comté.—L'Etoile and Quintignil, department of the Jura.

Bordelais.—Virelade, Arbanats, Budos, Pujols, Ilats, Langoiran, Cadillac, and Montprinblanc, and the fourth growths of the Graves, department of the Gironde.

Périgord.—Bergerac, Ste. Foy les Vignes, department of the Dordogne.

Forez.—St. Michel sous Condrieu, la Chapelle, and Chuynes, department of the Loire.

Béarn.—The first growths of Conchez, Portet, Aydie, Aubous, Diusse, Jadousse, Cadillon, Usseau, St. Jean Pougé, Ponts, and Burosse, department of the Basses Pyrénées.

WHITE WINES.—FOURTH CLASS.

Champagne.—A large proportion of the growths quoted in the preceding class, and those of the Riceys, department of the Aube.

Anjou, Maine.—Saumur, Parnay, Dampierre, Souzé, Turquant, Martigné Briant, Foy, Bablay, Beaulieu, St. Luygne, Savenières, St. Aubin de Luygne, and Rochefort, department of Maine et Loire.

Touraine.—Vouvray, department of Indre et Loire.

Burgundy.—Meursault, department of the Côte d'Or, as regards its wines called *seconde cuvée;* Côte Delchet, at Milly; Fourchaume, at Maligny; part of the Côtes de Troëne, at Poinchy; of Vaucompin, at Chiché; of Blanchot, at Fiey; and of Fontenay; Charloups, les Voutois, Maison Rouge, and les Beauvais, at Tonnerre; Bridennes, at Épinal; the vineyards termed Chapelot, Vauvilliens, la Preusse, Vaulovent, Lépinote; Montmain, Vossegros, les bas du Clos, and many others, at Chablis; those of Poire, Blamoy, Voie Blanche and Chaussans, at St. Bris and Champ; Gravière, at Vivier, department of the Yonne; Chaintré, Solutré, and Davayé, department of Saône et Loire.

Franche Comté.—Montigny, department of the Jura, and Millery, department of the Doubs.

Berry, Nivernais.—Chavignol, and St. Satur, department of the Cher; Pouilly, department of the Nièvre.

Auvergne.—Corent, department of Puy de Dôme.

Dauphiné.—The wines of Mercurol, and those called Clairette, at Die, department of the Drôme; the best wines of Vienne, and St. André, in the department of the Isère; the Clairette of la Saulce, department of the Hautes Alpes.

Bordelais.—The good Côtes de Cadillac, those between Bassens and Baurech, department of the Gironde.

Agenais.—Marmande and Sommensac, department of Lot et Garonne.

Gascony.—The best growths of Tursan, Côte de Lénye, and Haute Chalosse, department of the Landes.

Périgord.—The second qualities of the growths quoted in the third class of the department of the Dordogne.

Languedoc.—Guillerand, department of the Ardèche, Limoux and Magrie, department of the Aude; Laudun and Calvisson, department of the Gard; Gaillac, department of the Tarn.

Provence.—The wines of Cassis, department of the Bouches du Rhône.

Béarn.—The second growths of Conchez, Portet, Aydie, and the other vineyards of the department of the Hautes Pyrénées, quoted in the third class.

Roussillon.—St. André and Prépouille de Salces, department of the Pyrénées Orientales.

Bigorre.—Bouilh, Pereuilh, Castel Vieilh, and Périguières, department of the Hautes Pyrénées.

Ile de Corse.—Some of its white wines.

WHITE WINES.—FIFTH CLASS.

There being so many varieties, it is better to divide them into two sections, like the red wines of the same class.

First Section.

Champagne.—Chouilly, Montholon, Grauves, Mancy, Molins, Vinay, Maugrimaud, Beaumont and Villers aux Nœuds, department of the Marne.

Lorraine.—Bruley and Salival, department of the Meurthe, and Creué, department of the Meuse.

Bretagne.—Varades, Montrelais, Valet, la Chapelle Hulin, la Haye, Loroux, Palet, Maisdon, St. Fiacre, St. Géréon, St. Herblon, and Riallé, department of the Loire inférieure.

Anjou, Maine.—Clos de Jasnières, department of the Sarthe; Chaintré, Varrains, Chassée, St. Cyr-en-Bourg, Brezé, Courchamps, Mihervé, and Saumousset, department of Maine et Loire.

Touraine. — Rochecorbon, Vernon, Montlouis, and St. Georges, department of the Indre et Loire.

Blaisois.—La Sologne, Muides, St. Dié, Meusne, Vimeuil, St. Claude, Moret, and Montelivaut, department of Loir et Cher.

Burgundy.—The troisièmes cuvées of Meursault, department of the Côte d'Or; Montagny, Chenôve, Buxy, St. Vallerin, Saules, Bouzeron and Givry, in the arrondissement of Châlon sur Saône; Vivier, Beru, and Fley, in the department of the Yonne; Vergisson, Vinzelle, Loché, and Charnay, department of the Saône et Loire.

Franche Comté.—Poligny, and Lons le Saulnier, department of the Jura.

Bresse, Bugey, pays de Gex.—Seyssel, department of the Ain.

Nivernais.—Pouilly sur Loire, department of the Nièvre.

Aunis, Saintonge, Angoumois.—Chérac, and Surgères, department of the Charente Inférieure; and Champagne, department of the Charente.

Limousin.—Argentat, department of the Corrèze.

Dauphiné, Lyonnais.—Chanos Curson, and the other inferior growths of the department of the Drôme.

Bordelais.—The best wines of Entre-deux-mers, Lussac, Ste. Foy la Grande, and Castillon, department of the Gironde.

Périgord.—Several growths of the department of the Dordogne.

Gascony.—Montfort, Nousse, la Hosse, Gibret, and Baigt Caupenne, department of the Landes.

Provence.—Marseille, Gemenos, Aubagne, Allauch, la Treille, St. Julien, la Valentine, St. Marcel, and Plan de Cuges, department of the Bouches du Rhône.

Béarn, Bigorre, Roussillon.—All wines inferior to those mentioned in the preceding classes.

Second Section.

Picardy, Ile de France.—Pargnant, Cussy, Château Thierry, Charly, Essommes, and Azy, department of the Aisne; Mouchy St. Eloy, department of the Oise; Mignaux Auteuil, and Andresy, department of Seine et Oise; Côte des Vallées, at Chartrettes, department of Seine et Marne.

Champagne.—Ancerville, Vitry sur Marne, and Sézanne, department of the Marne; Bar sur Aube, and Rigny le Féron, department of the Aube.

Lorraine.—Some of the growths of the department of the Moselle, and other departments forming this province.

Bretagne.—By far the largest proportion of the produce of the vineyards of the department of the Loire Inférieure quoted in the first section of this class.

Anjou.—Trelazé, St. Barthélemy, Brain sur l'Authion, Distré, Antigné, Bas Neuil, Brion, and all the vineyards of the arrondissement of Segré and Beaugé, department of Maine et Loire; la Flotte, la Châtre, St. Cécile, Marcon, Château du Loir, Mareil, St. Benoist, St. Georges, and Champagne, department of the Sarthe.

Touraine.—Nozelles, Nozay, Lussault, St. Martin le Beau, Rougny, Chançay, and Langeais, department of Indre et Loire.

Orléanais.—Marigny, Rebrechien, St. Mesmin, Loury, and other growths in the department of Loiret.

Blaisois.—Mer la Ville, Troo, Artuis, and Montoire, department of Loir et Cher.

Burgundy.—Givry, and other wines of the arrondissement of Châlon sur Saône, Roffey, Sérigny, Tissé, Vezanne, Barnouille, Dié, Tanlay, Milly, Maligny, Poinchy, Villy, Cliché, Ligny le Châtel, Poily, Chemilly, Courgy, and others in the department of the Yonne; Certaux, St. Vérand, Pierreclod, Bussière, St. Martin, &c., department of Saône et Loire.

Franche Comté.—Many growths in the departments of the Haute Saône, Doubs, and Jura.

Bresse, Bugey, pays de Gex.—Pont de Veyle, and Bourg, department of the Ain.

Poitou.—Loudun, Trois Moutiers, and Châtellerault, department of the Vienne.

Berry, Nivernais.—St. Amand, and Bourges, department of the Cher; several vineyards in the department of the Nièvre; St. Pourçain, la Chaize and the Creuziers, department of the Allier; Chabris and Reuilly, department of the Indre.

Aunis, Saintonge, Angoumois.—St. Jean d'Angély, department of the Charente Inférieure; Cognac, &c., department of the Charente, produce wines suitable for the distillation of eau de vie.

Limousin.—Argentat, department of the Corrèze.

Auvergne.—Chauriat, department of Puy de Dôme.

Bordelais.—Entre-deux-mers, Libourne, Bourg, and Blaye, department of the Gironde.

Périgord.—Most vineyards on the left bank of the Dordogne.

Gascony.—Mugron, Laurède, St. Géours, and Poyanne, department of the Landes.

Provence. — Marseille, Gemenos, Aubagne, Allauch, la Treille, St. Julien, la Valentine, St. Marcel, Plan de Cuges, department of the Bouches du Rhône.

Languedoc.—All the wines which would belong to this class are distilled for eau de vie.

Béarn, Bigorre, Conserans, comté de Foix, Roussillon.—The inferior growths of these provinces.

Among the growths quoted in this section, those of Burgundy, the Bordelais, the Nivernais, and the Champagne yield the wines usually preferred as daily beverage; part of the yield of those of Touraine, Anjou, Blaisois, and Bretagne, are used for blending with common red wines, to which they impart lightness and agreeable taste, and of which they diminish the intensity of colour; most of the others are converted into brandy, or consumed where they are grown.

LIQUEUR WINES.

France, although on the whole it produces few wines of this kind, yet yields a quantity of very good ones, which bear comparison with most of those of other countries. They are made red and white.

FIRST CLASS.

Roussillon.—The muscat of Rivesaltes, department of the Pyrénées Orientales.

Dauphiné.—The *vin de paille* made in the vineyards of the Hermitage, department of the Drôme.

Languedoc.—The best muscat wines of Frontignan, and Lunel, department of the Hérault.

SECOND CLASS.

Languedoc.—This province produces many muscat wines, among which those of the second qualities of Frontignan and Lunel occupy the first place in this class.

Roussillon.—The red wines called "Grenache," made at Banyuls, Cosperon, Collioure, and Rodez, and those called "Maccabeo," at Salces, department of the Pyrénées Orientales.

THIRD CLASS.

Limousin.—The *vin de paille* of Argentat, department of the Corrèze.

Périgord.—The muscats of Montbazillac and St. Laurent des Vignes, department of the Dordogne.

Languedoc.—The muscats of third growths of Frontignan, Lunel, and those of Maraussan; the wines called "Picardan," grown at Marseillan and Pomerols; those called "Calabre," "Malaga," and "Madère," manufactured at Cette.

Comtat d'Avignon.—The muscats of Beaune and the "Grenache" of Mazan, department of Vaucluse.

Provence.—The red and white muscats of Roquevaire, Cassis, Ciotat, the Malvoisie of Roquevaire, and the best simmered wines of the department of Bouches du Rhône; the muscats of Beaune and the "Grenache" of Mazan, department of Vaucluse.

Ile de Corse.—Cape Corse

LIST OF THE SECOND-RATE VINEYARDS OF FRANCE[1] PRODUCING GOOD ORDINARY WINES.

AIN.

Red Wine.—Amberieux, Anglefort, Cerveyrieux Champagne, Culoz, Groslée, Lagneux, Machurat, Saint-Benoît, Saint-Rambert, Saint-Sorlin, Talissieux, Torcieux, Vaux Villebois, Virieux.

White Wine.—Pont-de-Veyle.

AISNE.

Red Wine.—Arancy, Bellevue, Bièvre, Craonne, Craonelle, Château Thierry, Crépy, Cussy, Jumigny, Laon, as regards the growths of la Cuisine and la Cave Saint Vincent, Mont Châlons, Orjeval, Pargnant, Piotard, Roncy, Soupire, Treloup, Vailly, Vassogne, Vourcienne.

White Wine.—Azay, Charly, Château Thierry, Cussy, Pargnant.

ALLIER.

White Wine.—Creuzier-le-Neuf et Creuzier-le-Vieux, La Chaise, Saint Pourçain.

ALPES (LOW).

Red Wine.—The second qualities of the Mées.

ALPES (HIGH).

Red Wine.—The environs of Ventavon, and the hills bordering on the Durance.

ARDÈCHE.

Red Wine.—Aubenas, Limony, Mauve, Saint-Péray, Sara.

White Wine.—Guilherand.

ARDENNES.

Red Wine.—Baldy near Vouziers.

[1] These must not be confounded with the "seconds crûs."

ARIÈGE.

Red Wine.—Bordes, Campagne, Engravies, Pamiers, Teilhet.

AUBE.

Red Wine.—Bar-sur-Aube, Bar-sur-Seine, Bouilly, Côte des Gravilliers à Neuville, Javernan, Laine-aux-Bois, Souligny.

White Wine.—Bar-sur-Aube, Les Riceys, Rigny-le-Féron.

AUDE.

Red Wine.—Aleth, Argelliers, La Grasse, Névian, Saint Nazaire, Villedaigne.

White Wine.—Magrie.

AVEYRON.

Red Wine.—Agnac, Cruon, Gradels, Lancedat.

BOUCHES DU RHÔNE.

Red Wine.—Arles, Aubagne, Châteaurenard, Eguilles, Marseille, Orgon, Tarascon.

White Wine.—Aubagne, Géménos, Marseille, Roquevaire, St. Julien, St. Marcel.

CHARENTE.

Red Wine.—Asnières, Linars, Moulidard, St. Genis, St. Saturnin.

CHARENTE-INFÉRIEURE.

Red Wine.—Beauvais-sur-Matha, Bussac, Chapniers, Fontcouverte, La Chapelle, Nouillers, Saintes, St. Julien de Lescap.

White Wine.—Chérac, La Rochelle, St. Jean d'Angély, Surgères.

CHER.

Red Wine.—Bourges, Fussy, St. Amand, Sancerre, Vasselay.

White Wine.—Bourges, Chavignol, St. Amand.

CORRÈZE.

Red Wine.—Allassac, Donzenac, Saillac, Syneix, Varetz.

White Wine.—Argental.

CORSE.

Red Wine.—Ajaccio, Bastia, Calvi, Cervione, environs of Corte, Luri, Rogliano, Sartène.

CÔTE D'OR.

Red Wine.—The so-called *secondes cuvées* of the districts of Beaune, Chambolle, Flavigny, Morey, Nuits, Pomard, Volnay, Vosne.

White Wine.—The *secondes cuvées* of Meursault.

DORDOGNE.

Red Wine.—Bergerac, Chancelade, Domme, Le Masnègre, near Montignac, Mareuil, Montmarvès, Mousac, St. Cyprien, St. Pantaly, St. Léon, Thonac.

White Wine.—Bergerac.

DOUBS.

Red Wine.—Besançon, Byans, Lavans, Liesle, Lombard Mouthier.

White Wine.—Milerey.

DRÔME.

Red Wine.—Alan, Châteauneuf du Rhône, Die, Donzère, Gervant, Montélimart, Montségur, Roussas, Saillans, Vercheny.

White Wine.—Chanos, Curson.

EURE.

Red Wine.—Bueil, Château d'Illiers, Menilles.

White Wine.—Nonancourt, Portmort.

EURE ET LOIR.

Red Wine.—Côtes of Macheclou and Clos Champdé, Roussière, St. Piat, Sèche-Côte.

GARD.

Red Wine.—Aiguesvives, Bagnols, Beaucaire, Calvisson, Jonquières, Lacostière, Milhaud, Pageault, St. Césaire, Vauvert.

White Wine.—St. Gilles, Tavel.

GARONNE (HIGH).

Red Wine.—Buzet, Cugnaux, Muret.

GERS.

Red Wine.—Mielan, Plaisance, Vertus, Viella Villecontal.

GIRONDE.

Red Wine.—Ambès, Arcins, Arsac, Aversan, Bacalan, Bassens, Bayon, Blanquefort, Bouillac, Bourg-sur-Mer, Camblancs, Camillac, Cissac, Civrac, Cussac, Labarde, La Libarde, La Marque, Léognan, Le Pian, Libourne, Listrac, Lormont, Ludon, Lussac, Machau, Moulis, Parsac, Poujeaux, Puinormand, Puisségrin, Quinsac, St. Christophe, St. Germain, St. Gervais, Ste. Eulalie d'Ambarès, St. Laurent, St. Martin de Mazerac, St. Sauveur, St. Seurin de Bourg, St. Surin de Cadourne, Samonac, Soussans, Tauriac, Vertreuil.

White Wine.—Cadillac, Castres, Cerons, Entre-deux-mers, Fargues, Langon, Laugorian, Léognan, Loupiac, Monprinblanc, Podensac, Portets, Toulenne.

HÉRAULT.

Red Wine.—Agde, Béziers, Castries, Cette, Frontignan, Loupian, Lunel, Mèze, Pézenas, St. Geniez, Sauvian.

INDRE.

Red Wine.—Concremiers, Latour du Breuil, St. Hilaire, Valençay, Veuil, Vic-la-Moustière.

INDRE ET LOIRE.

Red Wine. — Athée at Azay sur Cher, Balan, Bléré, Chargey, Chenonceau, Chinon, Chisseaux, Civray, Dierre, Épeigné, Françeuil, Fondettes, La Croix de Bléré, Langeais, Limeray, Luynes, Mones, Pocé, St. Avertin, St. Cyr-sur-Loire, St. Marc, St. Ouen, Souvigny de Chargey.

White Wine.—Chançais, Lusault, Nazelles, Noisay, Rochecorbon, Rougny, St. Georges, St. Martin-le-Beau, Vernon.

ISÈRE.

Red Wine.—Jarrie (Haute), Revantin, St. Chef, St. Savin, St. Vérand, Vienne.

White Wine.—La Côte St. André.

JURA.

Red Wine.—Blandans, Gérage, St. Laurent, St. Lothain, Vadans.

White Wine.—Montigny.

LANDES.

Red Wine.—Castelnau, St. Loubouer, Urgons.

White Wine.—La Côte de Lénye, La Haute Chalosse, Le Tursan, Monfort Nousse, St. Laurent.

LOIR ET CHER.

Red Wine.—Angé, Bouré, Chambon, Chaumont, Chissay, Faverolles, Lusillé, Mareuil, Mer-la-Ville, Meusnes, Montrichard, Onzain, Pouillé, St. Aignan, St. Georges.

White Wine.—Courchiverny, Mer-la-Ville, Meusnes, Muides, St. Dié, Suèvres.

LOIRE.

Red Wine.—Chavenay, Chuynes, Luppé, St. Michel, St. Pierre de Bœuf.

White Wine.—Chuynes, La Chapelle.

LOIRE (HIGH).

Red Wine.—Brioude, La Voute, Monistrol.

LOIRE INFÉRIEURE.

White Wine.—La Chapelle, La Chapelle-Hulin, La Haye, Le Loroux, Le Palet, Maisdon Montrelais, Riaillé, St. Fiacre, St. Gervais, St. Herblon, Valet, Varades.

LOIRET.

Red Wine.—Jargeau, St. Denis en Jargeau, St. Gy, St. Marc, St. Privé, Sandillon.

White Wine.—Marigny, Rebrechien, St. Mesmin.

LOT.

Red Wine.—Camy, La Pistoule, Lebas, Premiac, Pressac, St. Vincent.

LOT ET GARONNE.

Red Wine.—Buzet, Mont-Flanquin, Péricard, Sommenzac, Thesac.

White Wine.—Marmande.

MAINE ET LOIRE.

Red Wine.—Bellai, in the commune of Allones, Brézé, Chassé, Dampierre, Neuillé, St. Cyr en Bourg, Saumur, Varrains.

White Wine.—Beaulieu, Côteaux de Saumur, Dampierre, Foy, Martigné-Briant, Parnay, Rablay, Rochefort, St. Aubin de Luygnes, Savonières, Souzé, Turquant, Thouarcé.

MARNE.

Red Wine.—Avenay, Chamery, Champillon, Claveau, Damery, Fleury-la-Rivière, Mancy, Montelon, Moussy, Pargny, Reuil, Vauteuil, Vertus, Vinay.

White Wine.—Beaumont, Grauves, Mancy, Molins, Monthelon, Montgrimand, Villers-aux-Nœuds, Vinay.

MARNE (HAUTE).

Red Wine.—Château Vilain, Créancey, Essey-les-Ponts, Joinville, La Côte de St. Urbin, Prauthoy, Rivière-les-Fossés, Vaux.

MEURTHE.

Red Wine.—Achain, Bayonville, Boudonville, Bruley, Charrey, Côte des Chanoines near Nancy, Côte-Rôtie, Dom Germain, Ecrouves, Envezin, Essey, Idulnay, Lucey, Neuviller, Pannes, Pixérécourt, Rambertcourt, Rauille, Tinery, Toul, Vic, Wandelainville.

White Wine.—Bruley, Salival.

MEUSE.

Red Wine.—Apremont, Béhonne, Chardogne, Côte de St. Michel at Belleville, Creüe, Haroncôte, at St. Mihiel, Les Allouveaux, Les Rochelles, Ligny, Liouville, Loupmont, Naives, Rosières, St. Julien, Varney, Vaucouleurs, Vigneules, Warneville, Woinville.

White Wine.—Boncourt, Creüe.

MOSELLE.

Red Wine.—Ars, Dale, Nouilly, Semécourt.

White Wine.—Dornot.

NIÈVRE.

Red Wine.—Pouilly-sur-Loire.

OISE.

White Wine.—Mouchy St. Eloi.

PUY DE DÔME.

Red Wine.—Chateldon, Mariol, Ris.

White Wine.—Chauriat, Corent.

PYRÉNÉES (BASSES).

Red and White Wines.—Aubertin, Aubous, Burosse, Cadillon, Conchet, Dinsse, Moneins, Pons, Portet.

PYRÉNÉES (HAUTES).

Red Wine.—Castelnau-Rivière-Basse, Lascazères, Soublecauze.

White Wine.—Castel-Vieil, Périguières.

PYRÉNÉES ORIENTALES.

Red Wine.—Esparron, Le Vernet, Milbas, Oms, St. Nazaire, Terrats.

White Wine.—Rodez-en-Conflans, St. Nazaire.

RHÔNE.

Red Wine.—Charly, Cogny, Couzon, Curis, Iriguy, La Galée, Les Barolles, Millery, Montmélas, St. Forlin, Ste. Foy, Vauxrenard.

SAÔNE (HAUTE).

Red Wine.—Charicy, Gy, Ray.

SAÔNE ET LOIRE.

Red Wine.—Blacé, Buxy, Charnay, Chasnes, Chenôve, Chevagny, Jambles, Laines, La Ragal, Loché, Lurigny, Montagny, St. Gengoux, St. Jean de Vaux, St. Jullien, St. Marc, St. Vallerin, Sancé, Sanecé, Saules, Vinzelles.

White Wine.—Bouzeron, Buxy, Chenôve, Davayé, Givry, Loché, Montagny, St. Vallerin, Saules, Vergisson, Vinzelles.

SARTHE.

Red Wine.—Jasnières in the commune of l'Homme, near Château du Loir.

SEINE ET MARNE.

Red Wine.—Boissise, Côte des Vallées at Chartrettes, Féricy, Héricy, La Grande Paroisse, Moret, Sablon.

White Wine.—Côte des Vallées.

SEINE ET OISE.

Red Wine.—Athis, Boissy-sans-Avoir, Mantes-sur-Seine, Mons, Septeuil.

White Wine.—Mignaux.

SÈVRES (DEUX).

Red Wine.—Airvault, Bouillé-Loretz, Lafaye-Mongeault, Mont en St. Martin de Sauzaire, Rochenard.

TARN.

Red Wine.—Florentin, Lagrave, Laroque, Meilhart, Rabastens, St. Amarans, St. Juéry, Tecou.

White Wine.—Gaillac.

TARN ET GARONNE.

Red Wine.—Aussac, Auvillar, Fau.

VAR.

Red Wine.—Brignoles, Cuers, La Cadière, Laroque, Lorgues, Ollioules, Pierrefeu, St. Maximin, St. Nazaire, St Tropez, St. Zacharie, Tourves.

VAUCLUSE.

Red Wine.—Avignon, Châteauneuf de Gadagne, Morières Orange, Sorgues.

VENDÉE.

Red Wine.—Fay-Moreau, Les Herbiers, Luçon, Loge-Fourgereuse, Sigournay, Talmont.

VIENNE.

Red Wine.—Champigny, Conture, Dissais, Jaulnais, St. Georges les Bailleraux.

White Wine.—Roiffé, Saix, Salonne.

VOSGES.

Red Wine.—Charmes, Gircourt, Porcieux, Ubexy, Vincey, Xaronval. The best wines of the district of Neufchâteau are ordinaries of the second quality.

YONNE.

Red Wine.—Auxerre, Commissey, Coulange la Vineuse, Givry near Avallon, Joigny, La Côte de la Belle Fille at Jussy, La Vieille Plante at Pontigny, Marsangy, Neuvy le Sautour, Rosay, Rousson, St. Martin-sur-Armançon, Vermanton, Vezelay, Vézinnes, Villeneuve le Roi, Vincelotte.

White Wine.—Bernouil, Béru, Champs, Chemilly, Dié, Roffey, St. Bris, Sérigny, Tanlay, Tissay, Vézannes, Vivier.

CHAPTER XVI.

THE WINES OF ALSATIA; OF THE PALATINATE, OR RHENISH BAVARIA; OF RHENISH HESSIA; OF FRANCONIA, OR THE UPPER MAINE; OF BADEN, WÜRTEMBERG, AND HESSE NORTH OF THE MAINE.

WINES OF ALSATIA :—Vines and cultivation ; Knipperle ; type of cultivation.—Classification of the wines of Alsatia.—Alsatian liqueur wines, and second-rate vineyards. WINES OF THE PALATINATE, OR RHENISH BAVARIA :—Topography.—Mode of cultivation.—The closed-chamber training, or Kammerbau.—Prevailing vines.—Special description of the Traminer.—Advantages of the mixed sets of vines in the vineyards of the Palatinate. WINES OF RHENISH HESSIA :—Liebfraumilch.—Oberingelheim.—Scharlachberg.—Area of the vineyards of the villages in Rhenish Hessia. WINES OF FRANCONIA, OR THE UPPER MAINE :—Topography of Franconia.—The Leiste.—Cultivation of the vine.—Variety of vines in the Leiste.—Cellars of the Royal Castle.—The Stein.—Viticulture in the neighbourhood of Würtzburg.—WINES OF BADEN, WÜRTEMBURG, AND HESSE NORTH OF THE MAINE.—Markgräfler.—Affenthaler.—The Pfaffenwald.

WINES OF ALSATIA.

Vines and Cultivation.—These wines are similar to those of the Palatinate, to be described in the following section. They are white, and made of Riessling, Traminer, Burger, or Elbling, and Grosser Räuschling. There is also Sylvaner and Ruländer, or grey Pineau. Peculiar to the district is the "Knipperle" (Petit Mielleux), which fills the vineyards of Thann, Rickweiher, and Ribweiler. The cultivation is peculiar, and not very well adapted to the climate; it reminds us of the old cultivation of the Moselle district. The vines are trained to form elements, and each element receives every year a long fruit-cane, which is bent in an arch and fixed to the stakes. The grapes then get too high above the ground, and ripen with difficulty. But the best situations are cultivated like those of the Rheingau. Zahnacker and Trotacker

FIG. 74.—*Aspect of a typical vine in Alsatia in full bearing.*

at Rickweiher are celebrated by the researches which Boussingault carried on in them. Some parts are said to be free from spring frosts, but others suffer from them, and all are exposed to the early autumnal rains, which destroy a great part of the harvest, particularly in Sylvaner. The wines produced are consumed in the district, and in the adjoining parts of Switzerland. They were formerly added to Rhenish products of the lower districts, to make them milder, but now the reverse obtains.

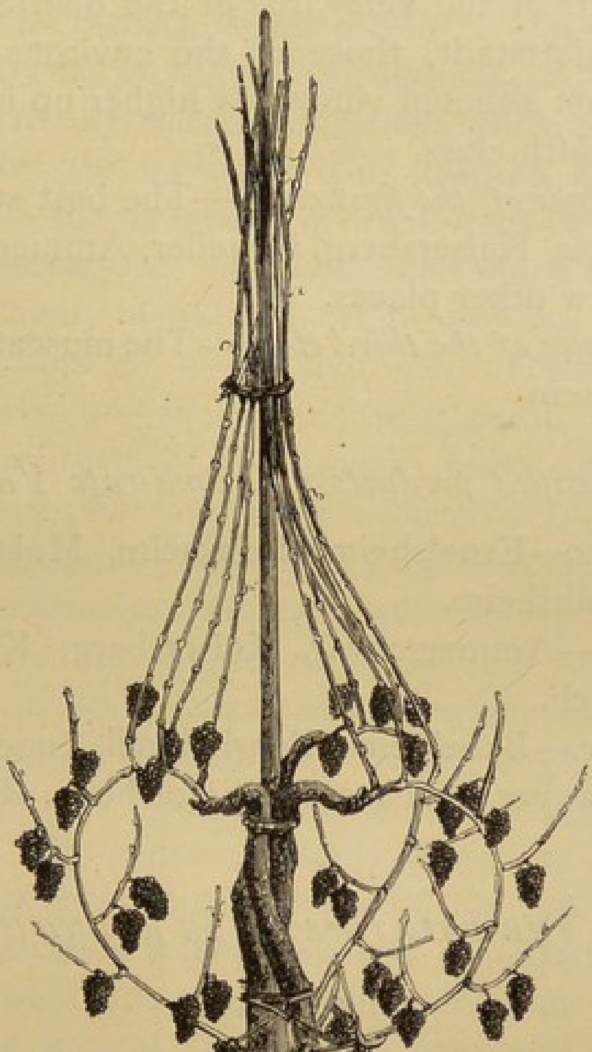


FIG. 75.—The typical vine without its leaves, to show its bunches of grapes and the adjustment of its wood, $\frac{1}{35}$. (Rickweiher, in Alsatia.)

Classification of the Wines of Alsatia.—Gebweiler, Türckheim, Rickweiher, Ribweiler, Thann, Bergholtzell, Ruffach, Pfaffenheim, Engisheim, Ingersheim, Mittelweyer, Hunneweyer Katzenthal, Ammerschwir, Kaiserberg, Kiensheim, Sigolsheim, Babelheim, Mülsheim, and Volksheim yield dry white wines of very good quality, ranking in the second class. The dry wines of the second quality of the growths named in the foregoing belong to the third class.

The dry white wines of Mutzig, Neuweiler, Ernolsheim, Imbsheim, Zabern, Reichsheim, and Habsheim belong to the fourth class.

The products of the vineyards of the districts of Weissenburg and Schlettstadt, those of the environs of Strasburg, and of the worst situated vineyards higher up in the province, belong to the fifth class.

Liqueur Wines of the first class.—The best straw wines are made at Colmar, Kaisersberg, Olweiler, Ammerschwir, Kiensheim, and a few other places.

Liqueur Wines of the third class.—The muscat of Volksheim and Heiligenstein.

Non-classified products of second-rate Vineyards:

White Wine.—Ernolsheim, Imbsheim, Molsheim, Mutzig, Neuweiler, Volksheim.

Red Wine.—Ammerschwir, Kaisersberg, Kiensheim, Olweiler, Walbach.

White Wine.—Babelheim, Bergholtzell, Ingersheim, Katzenthal, Mittelweyer, Pfaffenheim, Sigolsheim, Ruffach.

WINES OF THE PALATINATE, OR RHENISH BAVARIA.

TOPOGRAPHY.

The viticultural districts of the Palatinate are situated at the foot of a mountain called the Haardt, which is the continuation towards the north of the Vosges, and forms the natural frontier between France on the west, and between Germany—more particularly Rhenish Bavaria—on the east. The mountain consists mainly of sandstone. It rises rather rapidly to a height of from 600 to 800 feet, and is intersected by many valleys, which are mostly directed rectangularly upon the Rhine. The land at the foot of this mountain is in general between 50 and 100 feet higher than the general level of the Rhine valley, and forms, therefore, a kind of high plain, or a middle stage between the Rhine valley and the mountains. Its inclination is not very great, for the ascent from the plain to the termination of the viticultural district upon the steep inclines of the mountains is distributed over about four or five English miles. In the neighbourhood of Landau and Deidesheim, however, the district is more hilly. The valleys which run from west to east produce many undulations, and southern as well as northern exposures; but on the whole the exposures of the vineyards are east. In this respect, therefore, the Haardt resembles the situations of the Côte d'Or and some of those of the Champagne. The land upon which the vineyards are situated is chiefly of alluvial origin, and has been carried from the mountains by water and ice. Here and there, basaltic formations are seen, and the general formation, as well as the ingredients of the alluvial mass, show that the sandstone of the higher mountain is based upon clay, schist, and granite. At some points the grey old chalk becomes visible, as at Deidesheim, Neustadt, and other places, an important element in the consideration of the success of the vine. Marl and sand are found over the whole district, giving to the soil the peculiar faculty of producing large crops. The whole of this alluvial formation, from the mountain to the plain, is covered with vines, and only rarely are a few small meadows to be seen in the bottoms of the smaller valleys. If the traveller ascends a height—say a mountain near Burrweiler—his surprise at the expanse of wine-fields will be very great, for over an area of thirty miles long, and seven miles wide, the whole space is covered with vines. The 70,000 fuder of wine which are produced in this district, form about one-tenth of the total production of wine in the south of Germany. The wine of the Palatinate is celebrated for its medium good quality, the purity and freshness of its taste, and the extreme relative lowness of its price. Many have been the conjectures regarding the climatic advantages of the district which enable it to produce this wine, for here again the eastern exposure has appeared to present difficulties to the explanation that the good quality of the product was due to mere situation. We believe, however, that this difficulty is to be solved in the same manner as those which we have met with in the case of Burgundy and the Champagne. During the summer months, the air in that part of Germany travels during the daytime from the west to the east, and during the night from the east to the west ; during the daytime, therefore, the vines are protected against the general current by the mountains, and able to reap the full benefit of the radiant heat of the sun ; but in the evening, and during the night, the east wind brings to the wine-growing district an air which has travelled over the fertile plains of the Rhine valley, and been there warmed so as to be capable of beneficially influencing the vines.

MODE OF CULTIVATION.

The soil is here grubbed very deep, down to five or six feet, and in doing this the cultivator frequently endeavours to give to his vineyard a little fall towards the south. The plantations are made with blind canes or with rooted young plants. The renewal of vines in old plantations is performed in the usual way by means of layers. The distance between the single vines is about two and a half feet in one, and four and a half feet in the other direction. The mode of training the vine is here altogether peculiar, and different from that in any other country. It is called the "double-chamber cultivation," and extends from Landau to Maikammer. At Hambach and Dittesfeld the so-called "closed low-frame training" is usual. In all the villages east and south of the village of Haardt, the open low-frame training is usual. The celebrated situations of Ruppertsberg, Deidesheim, and Forst also have the open low-frame training.

THE CLOSED-CHAMBER TRAINING, OR KAMMERBAU.

The Kammerbau is a method of training the vine by which, when the leaves and branches are fully developed, a series of from twelve to fifteen vines, fixed to a particular frame, form a low chamber which is covered on all sides like an arbour or bower. The figures 76 and 77 illustrate the frame which is generally used, and require no explanation.

It is evident that this mode of cultivation entails a great expense for wood, and that the viticulturists are compelled to be very agile in stepping across the many impediments to their progress which they encounter when dressing the vines. The stem of the vines is allowed to grow to about the height of a foot, then two or three branches are cut to it, and each of those branches is allowed to have a long cane of seven or eight eyes for bearing, and a short spur of two or three eyes

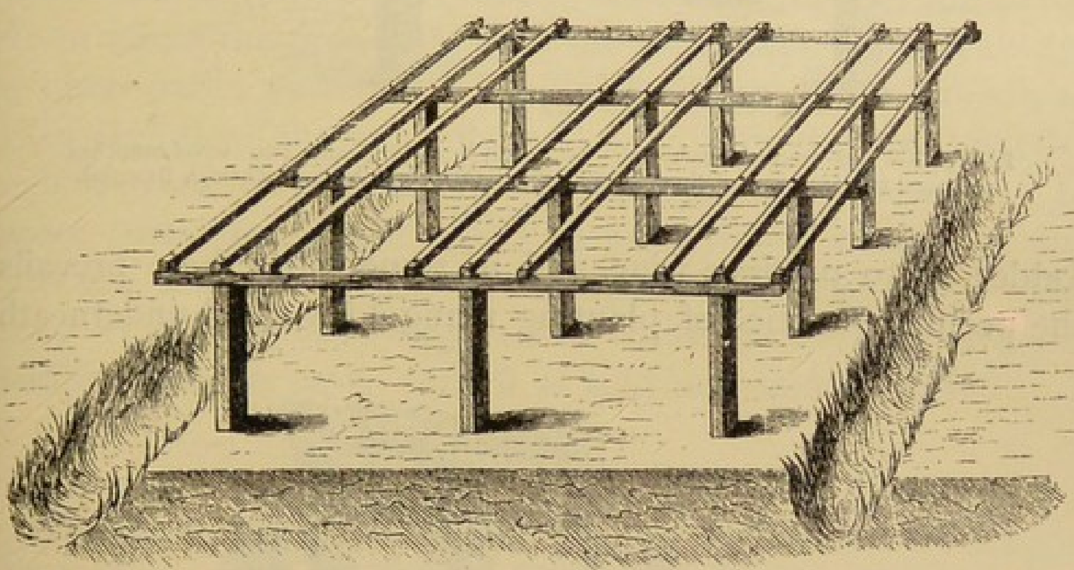


FIG. 76. Frame for training vines according to the method termed "Kammerbau," commonly used in Rhenish Bavaria (Palatinate) and at Weissenburg.

for yielding the new wood for the next year. The methods of cutting and tying the vines are illustrated in the figures 77 and 78.

To the vines so fixed, after the soil has been once dug round or worked with the hoe, nothing is done throughout the growing season. They are allowed to grow, and to cover the whole of the chambers as best they may. In September only the viticulturists go out to cut the superfluous branches, and this they do mainly for the purpose of producing fodder for their cows, which then begins to get scarce in the meadows and on the fields. Those branches which cannot be consumed green are dried for the winter. In the district of Weissenburg, and in Rhenish Bavaria, the vine is indeed used as much to produce

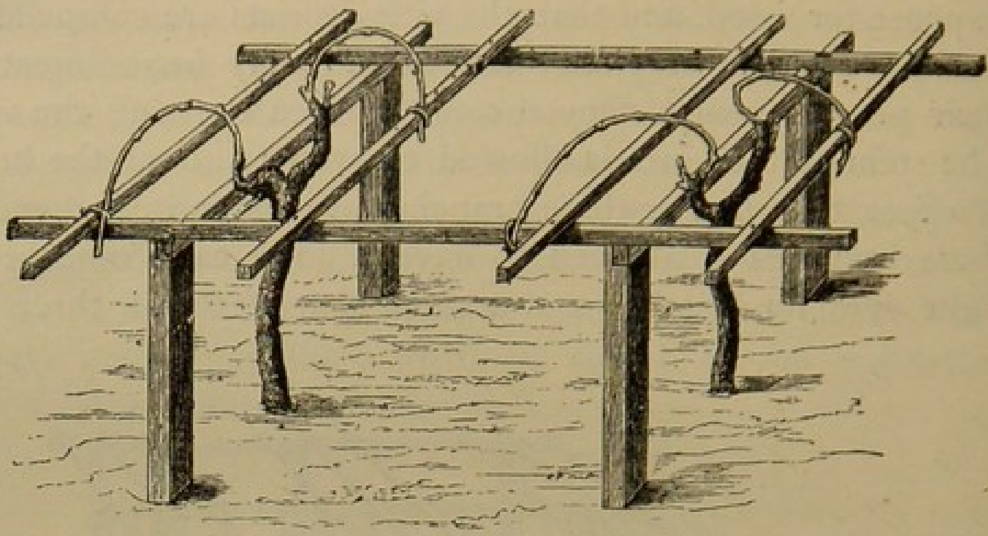


FIG. 77.—Vines pruned each upon two fruit-branches, and two wood-branches attached to the frames of the "Kammerbau" (Weissenburg and Rhenish Bavaria).

fodder as to produce wine, and in some parts there prevails the peculiar practice of planting mangold wurtzel underneath

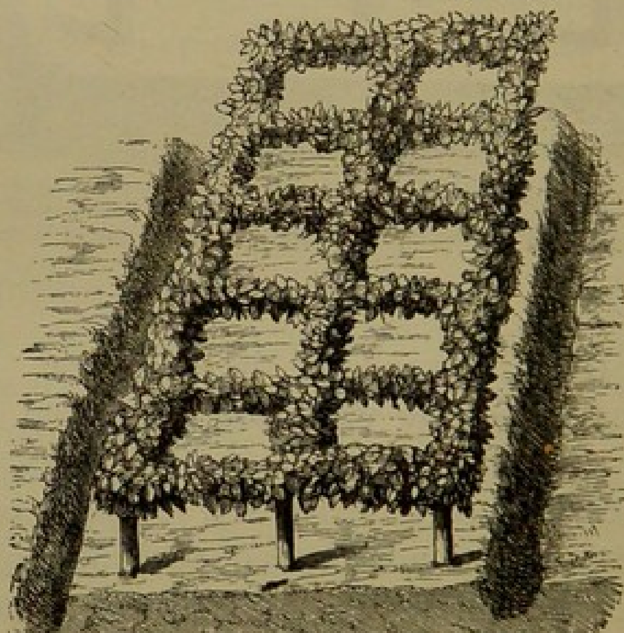


FIG 78.—View of a frame of the "Kammerbau" covered by vines in full vegetation. The subsidiary crops commonly grown underneath the frame are omitted. (Weissenburg and Rhenish Bavaria: Palatinate).

the chambers, whereby their thicket is greatly increased, and the chances of the ripening of the grapes very much diminished. The engraving (Fig. 78) illustrates the appearance of a Kammer after the branches have been cut off in September. We have no doubt that in the course of time this peculiar mode of cultivation will disappear, and will make room for the rational process which Schattenmann has for so many years successfully employed in Alsatia. This method is the same as that recommended by Guyot, and will, we have no doubt, prove successful in most places.

The method of closed chambers is most developed in the neighbourhood of Edenkoben. The vineyards in this district are divided by many beautiful paths and roads, and everybody has a convenient means of access to his property. Even where the properties abut on each other, there is always a grass path; and as the people are liberal in their roads, so they are liberal in their gifts, and do not mind if the traveller eats a grape or two in passing through their vineyards. In some parts the people agree to perform the vintage at one and the same time, and thus impose a vintage ban. The must is all put into large casks called *fuder*, and is never laid into smaller casks until it is sold and taken away.

PREVAILING VINES.

The vines which are mostly planted in this district are the Chasselas, called "Gutedel;" the Traminer; the so-called Austrians or Sylvaner; and the Riessling. The Ruländer, which we know to be a pale-coloured Burgundy, would no doubt be very useful in these districts if it did not ripen so much earlier than the other useful grapes. During the last decenniums the Traminer has gained a great preponderance over the other vines. Nearly all new plantations, particularly those which are made by persons of capital, are planted with Traminer, because its wine is more sought and better paid for. It is, indeed, singular that all the German wine merchants now sell their Palatinate wine, if possible, with the addition of the designation "Traminer." We will, therefore, give a short description of this interesting vine.

The name which this vine bears is most certainly a misnomer. It would indicate that the vine came from or was planted at Tramin, a little town in Tyrol, but travellers who have visited Tramin on purpose have not found a single plant in that district. Therefore the vine bears the name like *lucus a non lucendo.* We will not enumerate the many synonyms under which this vine occurs. Guyot terms it the *gentil duret,* which we therefore accept as the French name. It is a medium-sized vine with dark green shoots and medium-sized, thin, somewhat blistery, feebly-shining leaves. The leaves are dark green, frequently covered with loose wool, and not much incised. The bunch is small, dense, rarely loose, branched, pyramidal, multiple, and short. The berries are of nearly equal size, small and somewhat elongated, but the more ripe and juicy the more round they are. They are transparent, show veins, of a light red colour, and have a greyish blue bloom. The skin is thick and hard. The juice is of a mucous nature, very sweet and agreeable, and with a peculiar taste. The grape ripens early. The vine does not possess any great powers of vegetation or assimilation, and requires a loose, mild, and rich soil, which must contain chalk and sand. In heavy soils which retain the moisture the plant becomes decrepid and does not bear. It bears, however, in those parts where the upper ground is pervious and the lower ground retains moisture. The soil must be warm. It shoots early, and in consequence is exposed to the effects of early frosts. It is for this reason particularly qualified to be grown in the upper parts of the Rhine valley, Alsatia, and Rhenish Bavaria, where spring frosts are almost unknown. While other vines, such as the black Burgundy, when touched by the frost will effect a second shooting from the collateral eyes, the Traminer, if its first shoots have been touched by frost, does not produce any so-called secondary fruit-bearing branches. The cultivators therefore take care not to turn the Traminer vineyard with the hoe or spade too early in spring. The cultivation is effected in bows, such as will be described in connection with the viticulture of the Rheingau. To each vine there are left two or three canes to be tied into bows. The grapes do not rot easily, and can therefore be allowed to become very ripe. In the Traminer countries of the Haardt there may often be seen entire vineyards which have already shed their leaves but yet retain the beautiful red grapes of the Traminer. The wine made from this variety has a thick and so-called "fat" taste. It gives the impression of body with little acid and much smoothness. In exchange for that remarkable property of taste it is, during its early existence, very much exposed to become viscid. In order to remedy this trouble, the viticulturists allow the grapes to stand with the stalks for some days after they have been crushed, in order to effect an extraction of the tannin from the stalks, and thereby precipitate the albuminous matters which seem to have a share in the production of the viscidity. This process, however, entails the communication of a dark colour to the wine, which is not desired. If we are to believe the writers on the varieties of vines, the Traminer has migrated to the parts where it is now grown from Franconia. In Tyrol, where it occurs, it is called "Francon."

ADVANTAGES OF THE MIXED SETS OF VINES IN THE VINEYARDS OF THE PALATINATE.

The Chasselas ripens early, and almost every year; and, although it does not give wine that has lasting qualities, it yields tolerable substance without acidity. The Traminer gives wine of much body and smoothness, as already stated, but its lasting qualities during the first year are not great. The so-called Sylvaner yields a very fine liquid-tasting wine, without much particular flavour. The Riessling, on the other hand, in bad years, gives much acidity; but in good years it imparts to the mixture of the other qualities a beautiful bouquet. We have, therefore, after close consideration of the whole production of wine in the Haardt, little doubt that this mixture of vines is very sensible, inasmuch as thereby the best average is produced of which the changes and vicissitudes of the seasons will admit. Of course we will not say that the plantations of pure Traminer and pure Riessling which are now becoming more common in the direction of Worms are not to be encouraged and continued. Those who possess property, and courage to face the misadventures of pure sets, will, of course, also be rewarded by a splendid success in good years.

There are in the Palatinate 33,048 morgen of vineyards. Of these there belong to the first-class, 12,576; to the second class, 9,816; and to the third class, 10,656. Total, 33,048. It is estimated that a full harvest yields between 70,000 and 80,000 fuder of wine (1 fuder = 1,000 litres).

WINES OF RHENISH HESSIA.

The wines and vines of this province are so similar to those of the Palatinate on the one hand, and those of the Rheingau on the other, as not to require any special description. We give, however, an accurate statement of the area covered by vineyards in this rich and fertile district.

The average annual production of this area amounts to about one stück of 1,200 litres per morgen. The vineyards of Worms include the one south of the Liebfrauenkirche, which produces the "Liebfraumilch," a Riessling wine of fine bouquet. The district of Oberingelheim produces much red wine of the character of Burgundies of the second and third class, from Burgundy grapes, and furnishes considerable quantities of these latter for the production of mousseux. particularly to a celebrated manufactory at Rüdesheim. The district of Bingen is distinguished by the growths of Scharlachberg and Feuerberg.

The wines of Laubenheim, Bodenheim, Guntersblum, Nierstein, and Selzen possess individual reputations, and are often substituted for wines of the Rheingau. Many wines from the other villages, particularly of the Kreis Oppenheim, are sold under the title of Niersteiner, especially in England, where the name of this village is received with marked favour.

AREA OF THE VINEYARDS IN THE PROVINCE OF RHENISH HESSIA.

KREIS ALZEI.

Names of Villages.	No. of Morgen.
Albig	62
Bermersheim	6
Alzei and Schafhausen	150
Bornheim	34
Lonsheim	25
Erbesbüdesheim	20
Flomborn	4
Flonheim	100
Framersheim	160
Wahlheim	1
Heimersheim	38
Nack	15
Odernheim	150
Uffhofen	80
Weinheim	75
Wendelsheim	13
	933

KREIS BINGEN.

Names of Villages.	No. of Morgen.
Bingen	346
Büdesheim	724
Dietersheim	50
Sponsheim	32
Dromersheim	450
Gaulsheim	24
Gensingen	352
Grolsheim	100
Kempten	295
Ockenheim	400
	2,773

KREIS MAINZ.

Names of Villages.	No. of Morgen.
Kastel	130
Kostheim	204
Mainz and Zahlbach	131
	465

KREIS NIEDEROLM.

Names of Villages.	No. of Morgen.
Bretzenheim	25
Ebersheim	392
Essenheim	370
Finthen	20
Gonsenheim	57
Harxheim	142
Gaubischofsheim	180
Hechtsheim	60
Kleinwinterheim	30
Laubenheim	450
Niederolm	90
Oberolm	150
Sörgenloch	100
Stadecken	468
Weisenau	180
Zornheim	50
	2,764

KREIS OBERINGELHEIM.

Names of Villages.	No. of Morgen.
Appenheim	150
Aspisheim	216
Bubenheim	100
Budenheim	28
Elsheim	200
Engelstadt	500
Gaualgesheim	780
Grosswinterheim	400
Heidesheim	212
Horrweiler	250
Jugenheim	316
Mombach	114
Niederhilbesheim	60
Niederingelheim	300
Oberingelheim	800
Sauerschwabenheim	195
Wackernheim	120
	4,741

Names of Villages.	No. of Morgen.
KREIS OPPENHEIM.	
Bodenheim	883
Dalheim	165
Dexheim	56
Dienheim	521
Nudelsheim	122
Dolgesheim	64
Einsheim	30
Guntersblum	692
Hahnheim	275
Köngernheim	40
Lörzweiler	170
Mommernheim	146
Nackenheim	438
Nierstein	882
Oppenheim	286
Schwahsburg	203
Selzen	864
Waldullversheim	336
Weinolsheim	74
	6,247
KREIS OSTHOFEN.	
Abenheim	180
Alsheim and Hangenwahlheim	350
Bechtheim	540
Dittelsheim	80
Dorndürkheim	60
Eich	10
Eppelsheim	3
Hangenweisheim	12
Hessloch	60
Frettenheim	12
Mettenheim	150
Monzernheim	14
Osthofen	400
Westhofen	300
	2,171
KREIS PFEDDERSHEIM.	
Bermersheim	20
Dalsheim	80
Gündersheim and Enzheim	74
Gündheim	130
Carried forward	304

Names of Villages.	No. of Morgen.
KREIS PFEDDERSHEIM (*continued*) :—	
Brought forward	304
Heppenheim	140
Herrnsheim	165
Hochheim	50
Neuhausen	15
Hohensülzen	23
Horchheim	90
Kriegsheim	70
Leiselheim	37
Mölsheim	95
Mörrstadt	36
Monsheim	80
Niedersflörsheim	150
Oberflörsheim	6
Offstein	40
Pfeddersheim	300
Pfiffligheim	63
Wachenheim	15
Weinsheim	42
Wiesoppenheim	40
	1,761
KREIS WÖLLSTEIN.	
Badenheim	66
Pleitersheim	18
Biebelsheim	40
Ippesheim	54
Bosenheim	130
Eckelsheim	50
Freiaubersheim	100
Fürfeld	41
Hackenheim	30
Neubamberg	12
Pfaffenschwabenheim	180
Planig	185
Siefersheim	47
Sprendlingen and St. Johann	800
Steinbockenheim	3
Volrheim	85
Wöllstein	120
Gumbsheim	40
Wonsheim	8
Zotzenheim	77
Welgesheim	72
	2,158

Names of Villages.	No. of Morgen.
KREIS WÖRRSTADT.	
Armsheim	100
Schimsheim	40
Bechtolsheim	90
Biebelnheim	100
Eichloch	164
Ensheim	90
Friesenheim	54
Gabsheim	45
Gaubickelheim	250
Hillesheim	76
Niedersaulheim	360
Niederweinheim	80
Obersaulheim	140
Partenheim	419
Carried forward	2,008

Names of Villages.	No. of Morgen.
KREIS WÖRRSTADT—(*continued*) :—	
Brought forward	2,008
Schornsheim	278
Spiesheim	150
Sulzheim	200
Udenheim	250
Undenheim	102
Vendersheim	182
Wallertheim	80
Wörrstadt	250
Wolfsheim	60
	3,560
KREIS WORMS.	
Worms	269

RECAPITULATION.

Kreis	Alzei	933
,,	Bingen	2,773
,,	Mainz	465
,,	Niederolm	2,764
,,	Oberingelheim	4,741
,,	Oppenheim	6,247
,,	Osthofen	2,171
,,	Pfeddersheim	1,761
,,	Wöllstein	2,158
,,	Wörrstadt	3,560
,,	Worms	269
	Grand Total	27,842

WINES OF FRANCONIA, OR THE UPPER MAINE.

TOPOGRAPHY OF FRANCONIA.

The country anciently called Franconia, which is now comprehended under the name of the lower circle of the Maine of Bavaria, contains about 70,000 Bavarian tagwerke of vineyards, which is about the same surface as that cultivated in the whole of the kingdom of Würtemberg. Most of the wine grown there is consumed in the country. There is only a small quantity which is exported, and that is grown in the neighbourhood of Würtzburg. The district of Würtzburg is a large irregular basin, surrounded on all sides by hills, which are somewhat flatter in the east, but higher in the west. All their slopes and heights are planted with vines in every direction. It is stated that there are in that basin 6,000 morgen of vineyards. The best vineyard is the so-called Leiste, situated on the left side of the Maine, in a small side-valley between two hills south of the fort. Next in quality to this is the Stein, which is situated on the right bank of the Maine, close to the river. To the north from the Stein is the so-called Middle Stein, and behind that the Harp and Schalksberg. These pass into other situations, all of them provided with particular names; and these vineyards pass from the Maine all around Würtzburg into the plain to the east. The whole exposure may be said to be southerly, with the exception of the eastern part, which is inclined easterly. The wines of these situations in good years have a particular strength. If this be a genuine quality,—and there is no reason to suppose it not to be, as Bronner was quite satisfied about it,—it behoves us to investigate how it could be explained.

THE LEISTE.

The soil is a clayey chalk, with a mass of broken chalk-stones, the same as occurs in Würtemberg and the whole of Franconia. The hill upon which the fort stands is called Marienberg. The fort forms a high wall on the top of this hill, and reflects the rays of the sun upon the vineyard, which is right at its foot. The southern exposure of the hill, as well as the eastern, is made up of vineyards, which are situated, properly speaking, on and surrounded by the fortifications. One might say that the vineyards form the glacis of the fortress. This however refers, probably, by this time, to things that were, for according to the Treaty of Peace between Bavaria and Prussia, of the year 1866, the fortress of Würtzburg was to be razed. Now, these walls give a protection to the vineyards which nature could not easily afford. Protected against all winds, and shone upon by the sun, the vines here grow in an extraordinary manner, and produce an excellent growth every year. Even such vines as the late Hermitage become of quite delicate taste. Indeed, the vineyards of the Leiste may be said to be a month, or sometimes two months, in advance of the general vines of the country. The area of the Leiste vineyard is 85 Würtzburg morgen, or nearly 17 hectares.

CULTIVATION OF THE VINE.

Formerly, in the cultivation of the vine, four stakes were fixed to each plant, each at the distance of a foot from the vine. A cane was tied to each stake, and consequently a kind of square was formed, round which the new branches grew. It was found that this arrangement prevented the sun from striking the soil, and that the soil constantly had a temperature two or three degrees less than that which was obtained in vineyards with single rows of vines and single rows of stakes. The Rhenish method, which we shall describe in the chapter on Hochheim, was therefore adopted whenever new plantations had to be made. But where new plantations were not made the vine was so trained as to be fixed to four stakes standing in one line. Many of the walls are covered with vines.

VARIETY OF VINES IN THE LEISTE.

There are here planted mostly Riessling and Traminer, and nearly one-third of Elbling. There are also some so-called Franconia grapes, which we will describe as white Traminer. This vine has large grapes, and may probably be an indigenous plant. In our remarks on the origin of the Traminer (p. 533), we indicated our belief that it came from Franconia. There are also some Chasselas and some black grapes. One peculiar grape is yet grown here, the so-called Hermitage. This grape is of a yellowish-brown colour like the white Traminer, and has an exceedingly fine flavour, the taste standing midway between that of a ripe Riessling and a Muscatel, having neither the fine flavour of the Riessling, nor the gross flavour of the Muscatel. If this vine were cultivated in greater numbers, and a wine were made from its grapes alone, it might be something very excellent. The greater part of the Leiste belongs to the royal domains, and all the wine made there goes into the cellars which are underneath the royal castle of Würtzburg.

All the façades of the castle have cellars underneath, which are vaulted in stone and of splendid construction. On both sides of each vault there are casks of a size holding not less than from five to ten fuders. Many of these casks are remnants of the time when Würtzburg and its castle were the seat of a bishop who was also the ruler of Franconia under the Emperor. These old casks are often ornamented with apostles or saints. The largest of them is so high that in order to ascend to the top of it one is obliged to make use of a ladder of twenty-four steps. It was built in the year 1784, and contains 660 eimer. Not far from this is another which is greatly venerated, and which is called the Swede barrel, for in the year 1630 the Swedes destroyed everything in Würtzburg Castle but this barrel, which, remaining unperceived by them, was found full of wine after they left the country. The number of large barrels in all the cellars is 289. How many of them are full we know not. It is, however, certain that there are not 10 per cent of them supplied with wine. The Leiste wine of good quality is mostly carried to Munich and drunk at Court. Only a small quantity enters trade.

THE STEIN.

The Steinberg proper consists of old chalk. It slopes towards the Maine, and the vineyards abut upon it. No doubt the surface of the river has a great share in determining the favourable nature of the climate of the lower parts of the Stein, for the rays of the sun, as at Hochheim, are reflected by the water as from a mirror, and go to supplement the rays which fall directly upon the vineyard. The best part of the Stein is the property of the Catholic citizens' Hospital. It yields the wine which has been celebrated for some centuries, and termed the "Holy Ghost wine." This Holy Ghost wine can be bought only from the steward of the citizens' Hospital, and is sold by him in peculiarly-shaped flasks called bocksbeutel. These are bottles which have a wide belly compressed from the sides and a short neck. The contents of a bocksbeutel are 32 ounces. The cultivation of these vineyards is very careful. The drainage is most perfect. The prevailing vines are Riessling, Traminer, and Ruländer. There are a great many vineyards in the neighbourhood of the Stein, the wine of which is sold as genuine Stein, but the quality of which is very inferior to it. Much of the wine which is sold under the name of Stein wine in London, is Palatinate wine, which in Mayence and other places is filled into bottles of the shape of the bocksbeutel, and then sold as Stein.

VITICULTURE IN THE NEIGHBOURHOOD OF WÜRTZBURG.

The method of training the vine here pursued, which consists of bringing it to a head about half a foot above the ground, is also followed in Switzerland and a great part of the Jura. For that purpose the canes are planted, and as often as the vine is about to grow, the growth is destroyed, so that even the eye, which in the third and fourth year is left upon the short stump, is destroyed. From this arises the necessity in the vine, if it be vigorous enough to stand such treatment, of shooting a new branch from its wood, and this is accompanied with great thickening of the part from which the shoot comes. In the course of eight years, a head is thus produced about the size of an egg, and which, in the course of twenty years, reaches the size of a fist. The advantages of such a head are in the training and cutting, but the grapes which are obtained are generally small, and the wine is indifferent. So long as this mode of training is practised in the Würtzburg district, we cannot hope to get any wines thence. Vinification and the treatment of the wine are here carried on as on the Rhine, and, therefore, require no particular description.

WINES OF BADEN, WÜRTEMBERG, AND HESSE NORTH OF THE MAINE.

Würtemberg and Baden produce considerable quantities of wine, but as its quality is rarely above the fourth class, none is exported. The area of the vineyards of Baden is 51,532 Baden morgen: the quantity of wine produced annually exceeds 500,000 ohms; its value is estimated to vary between seven and eleven millions of florins. Growths of reputation are the white Markgräfler, which is the product of thirteen village districts, and the Affenthaler, a light, agreeable red wine. The area of the vineyards of Würtemberg is 54,600 morgen, of which more than half are situated in the valley of the Neckar. The average money value of the annual product is only three and a half millions of florins. Much of the wine has a pale red colour, and hence is termed "Schiller."

Hesse north of the Maine produces wine in the valley of the Kintzig, from Hanau to Gelnhausen. To the north from the latter town is Büdingen, which has a favourably situated vineyard called the Pfaffenwald. In a beautiful garden at the foot of this slope one of us early acquired that love for viticulture and its resultant sciences which finds expression in the present treatise.

CHAPTER XVII.

THE WINES OF THE RHEINGAU; OF THE LOWER MAINE; AND OF THE MOSELLE.

THE RHEINGAU: Topography.—Historical notes.—Varieties of vines cultivated in the Rheingau.—Special description of the Riessling.—General condition of the Rheingau.—HOCHHEIM.—Topography and soil.—Planting and training of vines. — Vintage. — Vinification. — Ellfeld (or Eltville). — Rauenthal.—Kiedrich.—The Steinberg.—Its farm.—Mode of planting and training.—Vintage.—Vinification.—The press-house.—The Cabinet.—The annual sale by auction. — Hallgarten, Vollraths, Marcobrunn, Hattenheim, Oestrich, Winkel.—The Johannisberg.—The castle; the village.—Geisenheim.—Rüdesheim, Hinterhaus and Berg.—Assmannshausen.—Red wines from Burgundian grapes.—Banks of the Rhine from Assmannshausen to Coblentz.—Area of vineyards in bearing in the former Duchy, now Prussian province of Nassau.—Tabular view of the proportion in per cents. which the vines planted in the ten divisions of Nassau bear to each other.—Rhenish measures of capacity. THE WINES OF THE MOSELLE: Topography.—Varieties of vines and modes of cultivation prevailing along the Moselle.—The vintage.—Characters of Moselle wine.—Area of the vineyards in the province of Rhenish Prussia.

TOPOGRAPHY.

THE country between the Taunus mountains on the north, and the river Rhein on the south, is generally known as the Rheingau. It forms a bay in the mountain more long than deep, and filled with undulating hillocks. Its eastern termination is near Schierstein and Walluf, a short distance below Mayence, its greatest width from north to south, amounting to three miles English, is at Steinberg and Hallgarten, and its western termination is at the Wisper, below Assmannshausen. As the inclination is generally towards the south, it is protected against all northerly winds, and the mountains on the west bank of the Nahe afford protection against the south-west winds. The river Rhein acts as a mirror, which reflects the rays of the sun towards the vineyards. This conformation of the country produces a climate most favourable to the production of those particular kinds of fragrant bouquetted wines for which the Rheingau has obtained a world-wide celebrity.

The base of the geological conformation is clay-schist in several varieties. At the Gräfenberg it contains much talc, at Rauenthal and Steinberg more quartz; at the back of the Johannisberg, the so-called Dachsbau, the schist alternates with granular masses of quartz, resembling some kinds of sandstone. At the Rothenberg, near Geisenheim, the schist contains much iron-hydroxide, the red colour of which gives rise to the name of the locality. At the Hinterberg, near Rüdesheim, the schist passes into roofing slate, and is also mixed with strong veins of quartz. The hills in the wider part of the Gau are diluvial formations containing fragments of the basal rocks. Their tops are plains of considerable extent, and they all have this peculiarity, that their eastern declivities are made up of loam and marl, giving a so-called light soil, while their western inclines are formed of clay, producing a heavy soil. The southern inclines are gravelly. All these formations can be seen in characteristic purity at the Johannisberg, and their peculiar influence upon the wine accurately determined.

In conjunction with the Rheingau we consider the district of Hochheim, which has furnished the monosyllabic English term by which all Rhine wines are confused into one curious superstition. Hochheim is situated upon the northern bank of the Maine, about three miles English east of Mayence. Its vineyards have no particular mountain protection in the north, but are situated on a declivity rising from the Maine, and terminating at the beginning of a great plain which stretches northwards round the south-eastern slopes of the Taunus mountain, in the direction of Homburg. By its soil, cultivation of the vine, and excellence of its product, it is properly considered in conjunction with the Rheingau.

HISTORICAL NOTES.

From some old historical documents yet extant, it appears the vine was cultivated in the Rheingau already in the sixth and seventh century. The tradition that the first plantation had been made by or in the time of Charlemagne is therefore a mere fable. The greatest extension, however, was given to the cultivation of the vine by the agency of clerical foundations, particularly the monasteries of Johannisberg and Eberbach, the inhabitants of which planted the vineyards of Johannisberg (1106), Steinberg (1131), and Gräfenberg. The benefits they conferred upon the surrounding country by their example of correct treatment of the vine and wine, and by their good taste in the selection of the most suitable varieties, they counteracted in later centuries to a great extent by oppressing the cultivators with tithes and imposts, for which they obtained the authority of the worldly power. At last these corporations were swept away by the Reformation or the wars consequent upon the French revolution, and their property passed into the hands of the Dukes of Nassau or the Princes of Metternich. Such vineyards, besides those of the foregoing estates as were cultivated up to the middle of the eighteenth century, belonged to the resident small proprietors or to country squires. But about a hundred years ago a great expansion of the cultivation took place, by the immigration of capital. Many rich merchants or private persons from Mayence, Frankfort, and towns even farther distant, acquired land and planted vineyards, and cultivated them by superintendents and work-people, whom they kept residents on the estates, while they themselves only came once a year to visit their properties, and to put their harvests into the cellars.

By this concurrence of intelligence and capital the cultivation of the vine and the process of vinification has reached a very high development in the Rheingau. The prices of products and properties exhibit a continuous and almost uninterrupted rise, and general prosperity is the result to all cultivators. But the main factors in the production of this favourable result are, besides soil and climate, the peculiar grape, termed the Riessling, which almost exclusively produces the bouquetted wines; the discovery that its highest qualities are only developed when it is in a state of over-ripeness or actual rottenness, without concurrent acetification; the care bestowed in the selection of suitable grapes, the rejection of all under-ripe or acid rotten grapes or berries, and the general perfection of the cultivation of the vine and processes and implements of vinification.

The recognition of the beneficial effects of these particular proceedings has wrought a complete reform in the treatment of wines in the cellar. While formerly young wine was necessarily harsh and acid, and required much time to develop its qualities, and while old wine only was esteemed, and nothing was deemed fit that had not been from ten to twenty years in the barrel, now, that the grape was allowed to ripen to the utmost on the plant, wine could be perfected in one-half or one-third the time that was formerly requisite. Now the wines of the Rheingau attain their full development in the third, fourth, and fifth year; this relatively increases their quantity, and cheapens the cost of production to the consumers. The proprietors then found that large casks, which they had formerly adopted, to diminish to the utmost the loss by diffusion and evaporation, were impediments to the quick maturation of the wines, by diminishing the surface for the access of oxygen, and consequently discarded them, and substituted everywhere pieces of not more than 7 ohm. In the smaller properties even smaller casks are employed for keeping the most select qualities.

VARIETIES OF VINES CULTIVATED IN THE RHEINGAU.

The Riessling is the characteristic and all-pervading vine of the Gau. Any other sorts grown by the side of it have to sink the individuality of their juice entirely in that of the former. The Riessling is durable, yields wood every year, ripens it in time before the winter frosts, is little liable to be affected by winter frosts, does not shoot too early in spring, and is therefore not easily nipped by May frosts. It is a short-wooded vine, and generally trained in plants of three or four branches each, rising, when cut in spring, no higher than a foot above the ground. When it stands in rich soil it requires long bow-canes, to develop its full bearing power.

The Riessling is also common in Rhenish Hesse, and in the Palatinate. Indeed, when one considers that in former years it was the exclusive vine of the country between Neustadt on the Haardt and Worms, one is almost led to believe that it was indigenous to that part of the Rhine valley. While it still produces excellent wines in this part, the wines of the Gau have obtained the greater reputation for their bouquet, and consequently the Traminer and Ruländer have much supplanted the Riessling in the Palatinate. The Riessling also predominates at Würtzburg, and enters largely upon the composition of the mixed sets in vineyards, in the valleys of the Rhine, Moselle, Maine, or Neckar and their smaller contributories. In Austria, Bohemia, Moravia, Styria, the Riessling also occurs, but more sporadically, and nowhere dominating. In Italy and France it appears to be perfectly unknown and uncultivated.

While, therefore, the Riessling is certainly peculiar to the Rhine valley, it is not equally certain, but highly probable, that it is indigenous to it. For it possesses all properties for successful growth and maturation in that part. Being a small vine, its fruit is developed near the soil, and receives its radiation of heat; its bunch is not large, its grapes also of small size, with little juice and much acid, with hardy skins capable of withstanding inclemencies of the seasons; and with great ability to ripen late in the year while hanging on the vine almost to the beginning of winter frosts. It is in the valley of the Rhine only that it attains the qualities which give high flavour to its wine. In any hotter climate, such as Hungary or Styria, it becomes excessively sweet, less acid, its wine assumes quite different qualities, being alcoholic and of fiery taste, without almost any of the bouquet which distinguishes Rhine wine.

The bunch of the Riessling is small and not very regular, its stalk is short and thick. The berries are very equal, round, not very juicy, of a light yellow colour, with greenish sap-vessels, black points distributed over the husk, and transparent. When very ripe it assumes a rose-red hue. During the last ripening the stalks dry and shrivel, and the bunches frequently fall to the ground.

The leaves of the Riessling are dark green, thick and rough. The appearance of the entire plant is mostly vigorous and striking, but not large or luxuriant.

Some peculiarities in the ripening of the Riessling grape we have given in detail in the general chapter concerning the ripening of grapes, p. 37. We have shown that the proportion of acid to juice diminishes by an increase in the amount of juice and sugar, but that the total quantity of acid in a grape is probably the same at maturity as a month before, and that, therefore, the formation of sugar cannot be assumed to have taken place at the expense of the acid present.

Of other vines, we have in the Rheingau a small number of the *Elbling*, or Albe, the Pedro Ximenez of the Xeres district. This vine is used to cover railings which form the enclosures of vineyards. In the district of Ellfeld the Elbling is mixed with the Riessling in the vineyard. It occurs yet frequently between Rüdesheim and Assmannshausen. The *Traminer* also is cultivated, but it is found to yield bad wood and to cease bearing, and is not likely to become more frequent. At the so-called Rüdesheimer Berg, particularly its southern and south-western declivities, the general vine is the *green Orleans* or *Rüdesheim Orleans* or Hartheinsch, a very late grape, which would not get ripe in any except the very best and warmest situations of the Rhine valley. From this particular grape, therefore, is derived the peculiar flavour and taste of the Rüdesheim wine, which must be well distinguished from the bouquet of the Riessling wine, and experience its own appreciation. The Scharlachberger wine is also made of the Orleans grape. In later years there has been a tendency to abandon this grape and substitute Riessling. But this seems little judicious, because the Orleans vine grows well in the rocky soil, is an abundant bearer of large-graped massive bunches, and attains an age of fifty years and upwards, qualities in none of which the Riessling becomes its equal.

Assmannshausen differs in many respects from the rest of the Rheingau, as we shall see when treating of its peculiarities in detail. The vines there cultivated also differ at once from those grown higher up. Only few vineyards with red, blue, or black grapes occur in the upper part of the Gau. But at Assmannshausen *the black Burgundy vine* or *the Pineau* is grown frequently, and gives the red wine for which this place is known. In many vineyards white grapes grow mixed with the black ones. The dominant white-graped vine is the *Kleinberger*, a variety of the Elbling or Ximenes grape, distinguished from this by a more incised and more serrated leaf, and by a number of small berries occurring amongst the larger grapes, whence its name, "small-berried," is derived. Mixed with these are a few true *Elbling* vines and a number of the variety termed "*Valtelliner.*"

GENERAL CONDITION OF THE RHEINGAU.

The cultivation of the vineyards is determined not only by the relative wealth of the proprietors, but by other natural and insuperable conditions. The vine must be manured; manure can only be obtained by the keeping of cattle; cattle must be fed. Now it is with regard to this latter point that the difficulty arises. There is very little meadow ground in the Rheingau, and the general agricultural surface is also limited, consequently everybody is obliged to husband all herbaceous products to the utmost. All weeds and cuttings from the vineyards are used for fodder, and too often weeds are allowed to damage the main crop of wine, because they are wanted for the very sustenance of animals. Here the rational practice of manuring by mineral means would be more applicable than anywhere else. It is necessary to consider these conditions in forming oneself a picture of the state of the Rheingau. Populous as it is, it lacks an agricultural substratum of fodder-production, and this engenders a one-sided reliance upon viticulture, which in bad years produces great want. Good years, on the other hand, make up for the losses of many years ; and the last few years having been generally good, everything in the Rheingau now is prosperous, and the prices of vineyards enormous. Of course, here, as in every wine country, there is much grown or produced that is not nectar, and a traveller going through the Rheingau will in inns and hotels get as sour and bad wine, as any that one can drink in the inns or hotels of the wine-producing parts of France, the Bourgogne, Mâconnais, or Beaujolais. This arises from the fact, that all better wines go to the near towns, particularly Mayence and Frankfort, and thence into the general trade, so that at Leipzig and Hamburg it is easy to get a good and genuine bottle of Rüdesheimer, while at Rüdesheim itself that is difficult.

WINES OF THE LOWER MAINE, OR OF HOCHHEIM.

TOPOGRAPHY AND SOIL.

Hochheim is a village situated on the northern side of the Maine, about three-quarters of a mile (English) from the banks of that river, 100 feet above its level, and about three miles above its confluence with the Rhine.[1] Its vineyards extend for two miles along the northern bank of the river, on an incline of from 4° to 5°. Their area is nearly 1,000 morgen, of 160 ruthen each. The Taunus railway, from Wiesbaden to Frankfort, passes through nearly their entire length. The exposition of the vineyards east of Hochheim is exactly southerly, that of the vineyards towards Mayence south-westerly. With the exception of those called Domdechanei and Stein, which are respectively protected towards the north by a high church and the houses of the village, the vineyards

[1] In a printed book on geography, which was given to the children of one of us in the school to which they had been sent, occurred the following catechization :—"*Ques.* For what is Germany remarkable ?—*Ans.* Because Hock grows there, and the sloth lives on trees. *Ques.* Where does Hock grow ?—*Ans.* At Hockstadt in Suabia." The author of this catechism stated on its title that he was a clergyman and a member of the university of Oxford.

have no protection whatever against the north wind, which is free to strike the vines in its course from the mountain towards the Rhine valley. It is therefore difficult accurately to define the conditions which produce so excellent a wine as that in the majority of the best reputed situations. The most important share seems to be due to the proximity of the river, which reflects the rays of the sun, and acts beneficially by the masses of warm water passing by. At least the vineyards gain in quality and price with their proximity to the water's edge. The "Kohlkaute," with an inclination of from 8° to 10°, is close upon the river. The "Lattenberg," and the "Hölle," with an inclination of 15°, and the "Gohltz," and "Wandkaute," are so near to the Maine, that when the river becomes swollen by rains many vines are under water.

The best vineyard is the "Dechanei," or deanery, which is ten morgen in extent, and has an inclination of only a few degrees. The so-called Church-piece, south of the church, yields the best wines, for which, in good years, prices up to £600 per piece (Rhenish) are obtained. The "Stein" is the eastern continuation of the Dechanei, and yields wines which are sometimes said to surpass the best Steinberg and Rüdesheim products. The comparison was made in the cellars of the Duke of Nassau, to whom these vineyards lately belonged. They are now the King of Prussia's, who happily rules, not only at Hochheim, but in the whole of the Rheingau.

The soil of the vineyards is generally a grey calcareous loam or clay-soil, with which higher up some gravel is mixed. The gravel appears as a layer of from one to two feet in thickness on the side towards Mayence, but rests always upon marl or loam, and no solid rock is struck in any part of the vine plantations.

The preparation for a new plantation always consists in a grubbing up of the soil to the depth of nearly three feet, and a subsequent fallowing for some years, during which clover and other fodder plants are grown. This preparation is essential to the success of new plantations, as the upper soil is exhausted by the cultivation of centuries, and the subsoil requires time and the action of the atmospherilia to open up its mineral ingredients to the roots of plants. A piece of land therefore comes rarely into full bearing in a shorter time than from seven to ten years after the grubbing. We have already in the general part shown the disadvantages of this practice, and the means for its improvement.

Planting and training of Vines.—When the ground is prepared the cuttings are planted. They are ripe canes of the last season, without any second year's wood. They are cut in February and March, and buried in the earth. In April they are placed in water, in the cellar or any other cool place, and planted in May. A hole is made in the ground with an iron rod, the cane inserted, and loose fine earth is run into the hole. Three such canes, planted at distances of less than six inches from each other, form what is termed a *plant*, in German "*stöck*." The head of the cane in the middle is marked and protected from injury by a small stake. The "stöcke" are planted in rows a little more than a yard distant from each other, parallel with the meridian, and the vines of each row alternate in position with those of the two rows on each side, so that all the vines of the even rows stand in one series of latitudes, and the vines of the uneven ones in another set.

The canes shoot in the first year branches of from one to one and a half feet in length. In the second year these shoots are allowed to grow without being cut. The three or four first eyes never grow secondary branches in that year, but remain dormant. In the third spring all the branches are cut off with the exception of half an inch of wood containing the dormant eyes. The earth is removed from the young plant, and all the roots of the upper node, which are termed dew-roots or day-roots, are cut off. The young vines are protected by stakes. When the vines shoot they are inspected, and only two branches left to each vine, and fixed to the stakes. In the fourth spring the weakest shoot is cut away entirely, and the strongest is shortened to two eyes. In the fifth spring the lowest cane is left with three eyes, and all the rest cut away. In the sixth spring the plantation is for the first time prepared for bearing. The vine has now generally three good canes, of which the lowest is left with three eyes, while the last one is cut so as to retain eight or nine eyes. Of each stock or set only two canes are used. The third individual plant is cut short and kept to growing wood during the year. The two long canes are then fixed to the stakes in the form of bows. Of these stakes, two are generally taken for each treble plant, but as each stake, which is placed equidistant between two "stöcke" is made to carry the end of one of the bows of each "stock," the canes of each treble stock are fixed (by means of osiers) to three stakes.

This arrangement affords to the vine-dresser the opportunity of so dressing each vine that its capabilities are fully consulted. If it is weak in the wood, it is cut back, if it is strong, good long canes are left. Some exhaust the bearing power of the vine by the appropriate length of the bows, and do not allow the short wood to bear too many grapes, because the grapes of the bows are less juicy, and less inclined to rot, than the more vigorous and watery grapes of the short wood, stump, or "knot." It is, however, probable that this opinion rests on the circumstance that the grapes from the short wood ripen earlier than the higher-hanging grapes of the bows. They should be collected earlier than those from the bows. When a vineyard is thus arranged for the season, it is one of the finest sights of field cultivation that can be witnessed. Everywhere the pleasing order of straight lines and geometrical arrangement, everywhere accuracy and neatness, and a fine comminution of the soil like that of the best-tended garden, nowhere weeds or disorder. It is clear that all human ingenuity can do has been effected to secure the condition of a fine produce.

As soon as the young shoots are developed, and the formation of flowers or "appearances" *Scheine* is completed, all superfluous growth is removed one joint above the last flower. This shortening is, however, not inflicted upon those shoots which are intended to give bows for the next year. These are left to grow freely. After the blooming all the shoots are tied up to the stakes with straw. When the grapes begin to ripen, the superfluous shoots, and all the wood rising higher than to within a foot of the upper end of the stake, is cut off. The soil is once more worked and weeded, and all preparations for the season are brought to an end, for the vineyards of the whole district are now closed until harvest-time, and not allowed to be visited by anybody except the members of the rural police. These keep watch against thieves and birds, and frighten the latter by repeated discharges of musketry.

The *vintage* is performed with particular care, and appears to be the most important part of the whole process of viticulture. It is negligently performed only by those of small property and means, to the great detriment of their interest and the deterioration of the produce generally. But the intelligent cultivators proceed as follows:—The commission having determined the day of the general vintage, a special inspection is held on the morning of that day, and, when the grapes are free from dew, a sign with the church-bell opens the vineyards. In case it should rain, however, the vineyards are not opened at all. Those who want to select, or make an "Auslese" as it is called, cut only the ripe grapes or the sweet rotten ones, leaving those less mature, and the vineyard is marked as not cleared. But those who are less careful cut all grapes and carry them away. As soon as this general vintage is over, the vineyards are again closed for ten days or a fortnight, when another vintage is effected. Here also many make a selection, and leave what wants or can bear improvement for another ten days, when the vintage is finally completed. This may be the middle or end of October, nay even the first days of November.

The proper degree of ripeness of the Riessling berry is recognized by the following signs:—The berry must be light brown and transparent, but not green; the kernels must be brown, and not white or light-coloured; the taste must be burning, sweet, and accompanied with the peculiarly strong flavour of the Riessling; the stalk must be shrivelled and dried like that of raisins.

During this ripening, many berries, and parts of grapes, or entire grapes, drop to the ground. All these are carefully collected by means of pins or otherwise, and added to the cut fruit. It is related that in the year 1775 nearly all the grapes lay rotting on the ground, and that one scarcely deemed it worth his while to collect them. These, however, yielded a wine which, after some time, was recognized to be the best growth that had been obtained in fifty years.

Vinification.—The grapes are generally trodden by men, in pails with a perforated bottom. In this process the husks are transformed into a pulp. The stalks are never separated, as their dry state effectually prevents the extraction of any tannic acid from them. The trodden mass is allowed to stand for twenty-four hours, and is then pressed in the ordinary wooden screw-press. The juice is put into the casks and allowed to ferment without any peculiar apparatus or precaution. The rest of the care of the wine does not materially differ from that bestowed in other parts. The bungs of the casks are very long, and always immersed in the wine. Four or five years are generally sufficient to make the wine ripe for bottling, after which it improves sensibly for many years.

ELLFELD (OR ELTVILLE).

This, the largest village in the Rheingau, is situated upon the bank of the river, and has a very extended viticulture. Its vineyards are situated to the north of the village towards the mountain. The most important position is the incline towards the river of a long ridge, running parallel with the river, about 100 feet above its level, and having a general exposure of south-south-east. The whole formation is a product of great masses of water, which must have come from the mountain. Its eastern side is loam, the southern declivity gravel, and the western clay. The best vineyards are the upper and middle "Sonnenberg;" then follow the "Sterzel," and "narrow way," which are situated lower and more towards the village. The south-western side of the ridge passes into a valley which runs towards Rauenthal, and here are the favoured positions of "Münchnach" and the "grey stone." The rest of the vineyards are of the third and fourth class only.

The mode of planting the vine is the same as at Hochheim, small differences excepted. Thus at Ellfeld the "stöck" consists mostly of four plants or footings; and if there are objections to the Hochheim treble stock, these of course apply with still greater force to the Ellfeld quadruple stock. It would be better to distribute the plants evenly than to crowd them, even though the tilling of the soil by spade and hoe should be made a little more difficult thereby. The fourth foot, the weakest among the set, is, however, frequently cut away. The Ellfeld vine-dressers also make the planting-canes a little too long—namely, two feet, while one and a half feet would be amply sufficient; they thus carry the lowest roots near upon hard basal unturned soil; in wet years the lowest roots are thus in the region of the greatest amount of water, and the vines quickly get sick. The roots of many of them die, and the vines having to rely upon the middle set of roots, all dew-roots being cut away, are insufficiently nourished and languish. Entire vineyards are thus exposed to unnecessary risks, which if they end in loss, damage the proprietor and enhance the price of the products of the other vineyards to the consumer.

The more intelligent and wealthy proprietors avoid fallowing, grub very deep, and plant the new ground with rooted vines. Thus time is saved, and the young vines are not exposed to the mishaps just mentioned.

The rest of the cultivation is the same as at Hochheim. The vine cultivated in good situations is the Riessling exclusively. In the inferior situations and the lower positions the Elbling is intermixed with the Riessling. The Traminer has been tried, but although favourable at first, it ceased to produce bearing-wood after a few years, and has gone out.

The vintage is here carried on as at Hochheim. Up to the year 1822 the people were compelled to harvest on the official day, because the paternal government took the tithes in natural products. Only then the influential proprietors succeeded in effecting a sufficient amount of liberation from this oppression, to be allowed to harvest at repeated intervals, as at Hochheim.

RAUENTHAL.

The vineyards of Rauenthal are situated upon the side of a long hill, which appears to be placed across the opening of a large mountain valley. The incline of the hill is very uneven and undulating in all directions. It therefore offers many exposures, and produces different qualities of wine.

The soil consists of disintegrated clay schist, and therefore contains many fragments of quartz. The east of the hill, termed "Nonnenberg" and "Rothenberg," has much loam. The best situations have a southerly and south-westerly exposure, such as the amphitheatrical "Gehren and Kesselring," and the "Wisshell," both with from 20° to 25° inclination. The "Geierstein" has 30° inclination, very stony soil, and is the extreme end of the good positions. From it the hill turns northwards, and, in the valley which it helps forming, only inferior wine is produced.

The cultivation of the vine is difficult, owing to the inclination and soil. The entire Rauenthalerberg was a forest up to the year 1626, when it was transformed into vineyards. Each rood of land was then charged with an annual impost of one pint of wine, which has remained the same during 300 years, and some years ago amounted in the whole Berg to 8 pieces 4 ohms.

On the vertex of the Rauenthalerberg is an ultimate eminence of white quartzy sandstone, where there was formerly a chapel. From this point one of the most beautiful views of the Rhine valley and Rheingau can be obtained, which vies in magnificence with that obtained on the Niederwald, above Rüdesheim. No mountains obstruct the view on any side, and as it is situated in the very centre of the Rheingau, it is a place which the peregrine œnophilist should visit himself, and recommend others to frequent.

KIEDRICH.

The vineyards of Kiedrich are situated about three miles from the Rhine, on the slope of the beginnings of the mountain. Their principal situation is the "Graefenberg," a vineyard which formerly belonged to the convent of Eberbach, and is now in the hands of private parties. Another very good situation is the "Mittelberg." Cultivation, plants, and vintage are here the same as everywhere in the Rheingau. The Riessling is, however, not kept so pure, and one sees much "Elbling" mixed with it.

THE STEINBERG.

This is the most famous vineyard of Germany, and one of the grandest establishments that can be imagined. Its administration, and the treatment of its produce, are simply perfect. It was formerly the property of the convent of Eberbach, and the visitor having seen all that belongs to the establishment, can form an idea of the amount of the pious gifts of worldly goods which the believing mass of the people must have placed in the hands of the monks, to enable them to form and keep such costly works. The Steinberg, after the secularization, became a Nassovian domain, and is now public property of Prussia.

The Steinberg is a hill about three miles distant from the Rhine. It is a long oval of about eighty morgen surface, and forms one uninterrupted vineyard, all of which is enclosed with a thick wall, twelve feet high, and protected from the weather by a roof of timber and slate. On the eastern side towards the convent the wall is pierced by a great number of doors, through which the produce is carried to the convent. The entire vineyard is separated in two halves by a carriage-way running through its length, and into several divisions by ways running at right angles to this main road. All parts of the plantation can thus be reached by means of horse and cart. The northern part is situated near to, and partly surrounded by, the forest, which, of course, produces some climatic disadvantage. But the high mountains immediately behind ward off any far reaching north wind, and the high wall, together with the natural south-westerly inclination, keep out the east wind. The entire vineyard is most scientifically drained by means of drains of masonry, which are below the lowest reach of the roots of the vines. The whole is ornamented with two pavilions, which impart some animation to the otherwise somewhat monotonous scenery. In short, all artifices are here united to gain from a naturally favourable soil the utmost quality and value.

But the vineyard itself is only one-half of the agency by which such excellence is produced. The other half is the farm at the foot of the vineyard, which is kept for the sole object of producing the necessary manure for the vineyard. To this farm there are attached 200 morgen of meadow land, and 400 morgen of arable land. Besides, there are furnished to the farm 12,000 trusses of straw. One hundred and sixteen head of cattle are kept, besides the draught animals, and the entire amount of manure thus produced, namely a thousand so-called double-carts full, each being equal to a load for two horses, or twenty-four cubic feet, is annually carried into the vineyards. Each morgen of vineyard receives every three years forty such double-carts full, each double-cart being distributed to sixty-four vines, so that the entire quantity of manure produced is barely sufficient, and sometimes supplemented by bought manure. The farm-buildings are situated at the lowest end of the vineyard, and surrounded with a wall, which is pierced by gates leading into the vineyard, so that the farm carts can enter the vineyard directly from the farmyard.

It will thus be seen that the Steinberg wine is virtually the product of 680 morgen of land, and not of the 80 morgen of vineyard only. But more and worse has to be related. The farmer or farmers (for sometimes there are two of them) are bound to buy all the manure they want for meadows and fields, in the neighbourhood or in the towns on the Rhine. The producing power, or mineral manure of a great number of small proprietors, who want money, and do not understand that in their manure they are selling a piece of their soil, is thus, through the practice of ages, being gradually transferred into the Steinberg vineyard. This must produce a constantly increasing contrast between the products of the general country around, and the all-absorbing great property.

The Steinberg vineyard appears, when seen from a distance, to be an even plain, but on close inspection this illusion is dissipated. It has various undulations and hollows, by which it is divided into districts yielding different produce. Of these, three are particularly famous and reputed to yield the best wine, namely, "the golden beaker," "the garden of roses," and the "plänzer." The latter yielded the best piece of cabinet wine in the famous year 1819. These hollows are situated in the very centre of the entire vineyard, are open towards the south-west, and enjoy particular protection by the higher parts of the vine-bearing land. Their soil is a talcy clay, resting upon the clay schist, of which it is the product of disintegration. Contiguous to the golden beaker is the "Friedrichshöhe," which forms the highest point of the vineyard, and towards the north abuts upon the forest-covered heights. This district, about two morgen in extent, was some years ago stocked partly with Riessling, partly with Traminer; but as the latter did not fulfil the expectations that had been formed of them, they have again been removed. Their non-success was probably due to the want of caution in planting them in the highest part, while their peculiarity would have required the lowest situation.

Mode of Planting and Training.—The lines of the vines do not run with the meridian, but are directed to the south-west. The plantation is the same as at Hochheim and Ellfeld. The work is performed by specially appointed vine-dressers, called "Weinbergs-Hofleute." They work, however, by contract, and after special instructions. We have a copy of these instructions, and find them a most accurate and intelligible short guide to viticulture adapted to the Rheingau.

The summer treatment is very simple, thinning of the herbage being effected only at the base of the vine; no shoots from the bows are shortened, but everything is left to free development and tied up to the stake. The canes assume a length of 10 to 15 feet, and are only shortened down to five or six feet when they assume a brown colour. This treatment produces small-berried loose grapes, which do not rot so easily, and admit the air better; they are thus qualified to hang longer upon the plant, and assume the utmost possible degree of ripeness. These small-berried grapes have given rise to the opinion that there are two kinds of Riessling, the small and the large. But it is easy to transform the small Riessling into the large, by short pruning and manure, and by thinning the herbage, and breaking the shoots above the grapes, and on the other hand, to transform the large Riessling into the small, by leaving it uncut, or with much wood, and by allowing it to grow rank and in all directions. Such a treatment has the same effect upon many, probably all, varieties of vines and grapes.

The Vintage of Steinberg is now, since the experience of the year 1822, always very late. In that year, the month of October being dry, the superintendent risked for the first time to let all grapes get into the state of sweet rottenness, and great was the dismay of the Duke of Nassau and his family, when they arrived to assist at the harvest, and found not a single grape fit to be eaten. But when the wines made from these grapes came to the hammer, they realized prices which astonished everybody. In ordinary years there are two or three selections of grapes, the first selection giving the best wine (Auslese). The rest of the grapes hang ten or fifteen days longer, and are then collected. The selection is made by experienced vine-dressers only. All grapes must be free from dew; all grapes which are lying on the ground are picked up, and all single berries are picked up with the aid of long needles, which the vine-dressers carry attached to a button-hole by a string.

Vinification.—The squashing of the grapes was formerly effected at Steinberg, as in the whole Rheingau, by means of so-called grape mills. But it was found that these machines did not sufficiently break up the husks, in which the principles are contained which give to the wine the bouquet, and the mills were consequently abandoned. The grapes are now trodden by men, as at Hochheim, wearing long boots, called wine-boots, made and kept for that purpose only. The boots have heavy soles, and are strongly fortified with iron nails. The treading is effected in a pail with a perforated bottom, which is fixed upon another larger pail; this latter receives the juice trickling through the holes, and when the comminution is completed, the entire pulp is removed into it through the large bung-hole in the centre of the perforated bottom. At the side of the board, by means of which the upper pail is secured upon the lower, a boot-jack is fixed, so that the boots may be taken off immediately, and not touch the ground under any circumstances.

The stalks are never separated from the berries; for it has been shown by repeated experiments that they do not communicate any taste to the wine, as they are in a state of dryness, and remain so in the must even if it should be left standing for some hours or an entire day. In the year 1833 the entire vintage was unstalked, and the berries pressed by themselves; the stalks and what adhered to them yielded, on pressing, 2 pieces of wine, the berries, 56. The wine from the stalks was at first rough, but it improved later considerably, and was sold at £50 per piece. The average sale price of the 56 pieces of berry wine was £65 per piece. It was therefore estimated that the presence of the stalks in the pulp produced so small a depreciation of the entire vintage, and that their removal was, on the other hand, so troublesome and costly, that it was determined henceforth to leave stalks and grapes together, as of old.

The Press-house.—The press-house and cellars are at the former convent of Eberbach. The monks finding their church too small, built a larger one, and devoted the old building to the service of Bacchus. Where before stood the altar, they now placed ten magnificent wooden wine-presses, of colossal form, great durability, and splendid materials. The rest of the church was filled with pails, baskets, vats, and countless apparatus, to be used at vintage time. The church is kept in the same state now. The wine-boots, filled with oats and well greased, are hung up on the wall to await their autumnal occupation.

Opposite this church is a smaller hall, with cross vaults and stone pillars. Here there are put up three presses with iron screws, in which the cabinet wines are pressed.

Close to this latter hall is the so-called *Cabinet*, where the cabinet wines are kept. This is a vault above ground, but protected by double walls and by trees and shrubs from the external heat of the atmosphere and rays of the sun. It has therefore the same equable temperature as the best vault underground. In very hot weather it is, however, kept cool by the floor being sprinkled with water, for which purpose a special pump has been arranged in the cabinet itself.

On another side of the small pressing-hall is a large hall, in which the new pieces or casks are kept and prepared for the reception of the vintage of each year. All wine which is not kept in the cabinet is placed in the large beautiful cellar, and there prepared for sale.

The annual Sale by Auction.—In every year, at the time in spring when wines are usually racked from the lees, there is a public sale of Steinberger wine at Erbach. The day of this sale is a great public festivity for the people of the Rheingau, and the wine merchants of Mayence and Frankfort. Each stranger arriving at Erbach, whether he be a buyer or not, is treated to a dinner and a liberal allowance of good wine, cabinet-wines being served with the dessert. There is, consequently, a great confluence of the curious and idle, besides the actual men of business and their friends, to partake of the judicious hospitality of the Government. It is judicious, for the animated people buy with more readiness, and the sale goes off amidst general merriment and satisfaction.

The auction wine is sold in pieces of $7\frac{1}{2}$ ohms each = 1,200 litres, and the price bid carries the cask. But the cabinet wine is also sold by private arrangement, in smaller quantities and frequently in bottle at high prices.

At the auction, the wine not only of the Steinberg, but also that of other domainial vineyards, such as those of Hattenheim, is sold. As the Steinberg produce amounts in some years to 84 pieces, from 120 to 150 pieces may now and then be sold together at one auction.

There can be no doubt that if, on the one hand, the Steinberg vineyards have consumed much of the manure of the Rheingau, they have, on the other hand, greatly raised the reputation, and consequently the money-value, of Rhine wine in general.

The price of Steinberg wine varies from £65 per piece to £600 and £700; the latter being the most exceptional and finest cabinet wines.

There are many villages at the foot of the mountain with good vineyards, such as *Hallgarten* and *Vollraths*, all of which have the usual vines and modes of training. The more important situations, however, are nearer towards the Rhine. Thus between Erbach and Hattenheim the celebrated *Marcobrunner* grows close to the Rhine.

The vineyard of *Marcobrunn*, the best growth in the commune of Erbach, abuts upon the highway, and is traversed by the railway, which runs a few hundred feet from the border of the Rhine. Its exposure is southwards, inclining a little to the west; it rises at angles to the horizontal, varying between 5° and 8°, and attains a total height of 60 feet above the level of the highway. Its general conformation is that of a flat basin. The upper part of the Marcobrunn is called "Silzberg," the nearest vineyard towards Hattenheim "Mannwarth," to which are joined in the direction of Hattenheim the "Nussbrunnen," "Stabel," and "Hasselt." The district of Marcobrunn proper has a clay soil, and is only 23 morgen in extent, of which 14 belong to the Nassau domains, and the other 9 to the Count Schönborn. The wine grown nearest to the highway is the best. In the middle of the front of the vineyard towards the highway there is a niche, from which through an iron tube a cool and clear spring of water gushes forth; it is possible that this circumstance gave the name to the situation. The "Nussbrunnen" vineyard, somewhat higher and more towards Hattenheim, has a similar spring.

Hattenheim, Oestrich, Winkel. — *Hattenheim* has some excellent vineyards, stretching for some distance westward of the village. Such are the "Engelmannsberg," with 15° of inclination, the "Willborn" and the "Schützenhäuschen," with from 10° to 15° of inclination and south-west exposure.

In many of our researches on the general characters of the average of good Rhine wines we employed a Hattenheimer Engelmannsberg, vintage 1862, with a magnificent bouquet, great body, and medium alcoholicity. Its somewhat prominent acidity and a trace of opalescence were due to its youth, and became diminished by rest in bottle. This wine would have sold in the trade at about £18 the ohm.

From Hattenheim, passing *Oestrich*, *Mittelheim* and *Winkel*, the entire country is undulating until it reaches the Johannisberg, and rises but feebly and slowly towards the mountain in the north. This entire flat basin is an enormous vineyard, six miles English long and three miles broad, but as its expositions vary considerably, the qualities of their growth are also different. The culture of the vine is the same as that which is general in the Gau. The Riessling vine predominates, but in the lower parts there is yet much "Elbling," old vineyards having up to one-half of their plants of the latter variety. In former times entire vineyards were planted with the Elbling exclusively. In the last years some Traminer plantations have been made.

THE JOHANNISBERG.

The Johannisberg is a conical hill, projected from the Taunus mountain to within about a mile of the river Rhine. Its highest point is occupied by the castle, and rises about 150 feet above the level of the Rhine. The vineyards surrounding the hill on several sides have south-easterly, southerly, and south-westerly exposures. The inclination varies considerably, and determines great varieties in the quality of the produce. The six morgen of vineyards at the foot of the southern declivity, termed the Klausenberg, have only a feeble inclination, and produce the least valuable wine, while the Langeberg, in the middle of the southern exposure, with 21° of inclination, produces the second best wine. The Oberberg is the upper third of the vineyards immediately surrounding the castle; its inclination varies between 9° and 18°, and owing to the protection afforded by the high castle against northerly and easterly winds, and the reflection of the rays of the sun from its surface, produces the best wine on the estate.

The Johannisberg was originally a Benedictine Abbey, founded in 1106 by Ruthard, Bishop of Mayence. The property and prerogatives of this convent were so much increased in the course of 200 years, that it played an important part in the history of the middle Rhenish countries. Through wars and adverse circumstances of various kinds, the Johannisberg changed proprietors frequently, and was at last bought in 1717 by the Abbot of Fulda, Adalbert von Walderdorf, who built the present castle. At the time of the French Revolution the Johannisberg, by some means or other, came into the hands of the then Prince of Orange, but it was again taken from him after the battle of Jena, and given by Napoleon to Marshal Kellermann. In 1815 the Emperor of Austria took possession of it, and on August 1, 1816, gave it to Prince Metternich, with whose descendant it now remains. The proprietor, however, pays annual wine-tithes to the Imperial House of Hapsburg.

This property has 62 morgen of vineyards, which are manured by the entire produce of a farm of 450 morgen of arable land and 70 morgen of meadow land, a provision which we have already considered when describing the Steinberg. The manure wanted for fertilising the 520 morgen of farm land is bought from the small proprietors in the neighbourhood.

As the soil is very different in the various parts of the vineyards, owing to the geological conformation which the Johannisberg has in common with most of the hills of the Rheingau, and which we have already sketched in the paragraph on topography, these parts are marked off by white-coloured stakes, with numbers affixed. The cultivation and the vintage are specially adapted to the particular condition of each part.

The cultivation is that which is usual in the Rheingau, and which we have described in the general part. We have perused the printed instructions which the steward gives to the twelve vine-dressers of the estate, and have found them clear and intelligible. The selection of grapes is made with the utmost care. From the 17th to the 20th of October, there is frequently a first "auslese," in those portions of the vineyard where the grapes are most advanced. The hours are mostly between 12 and 4 P.M. Frequently the best berries of each vine are picked out and united, and the rest is thrown with the general harvest. This troublesome business is rewarded by excellent produce; the fermented must is frequently rich in sugar. Indeed, such wine loses the character of Rhine-wine, and acquires some resemblance to the finest Muscat.

In the year 1834, the blooming of the vine passed over very quickly and satisfactorily, and the sweet rottenness of the grapes occurred very uniformly. No "auslese" was consequently made, but all grapes were cut at the same time. However, the rotten berries were all collected separately, and those which were sound were collected by themselves. All berries on the ground were picked up with steel dinner forks. The rotten grapes gave the first, the sound but perfectly ripe grapes the second quality of wine.

It is related that the advantage of the late vintage was discovered by the accident, that the Bishop of Fulda, in 1775, having received the report of his steward, forgot to send the customary order for the vintage. This was, therefore, deferred until, after nearly all the grapes were rotten, the frightened steward obtained the permission through an express messenger. The wine was, against all expectation, found to be of unprecedented quality, and the lesson was remembered ever after.

The press-house contains four presses. The cellar is situated under the entire castle, and has therefore, like that, a long front and two side wings running northwards. The entrance to the cellar is at the western wing by a large wide staircase. A portion of the cellar on the left contains store bottles, boxes, and all requisites for packing bottles which are to be sent to a distance. Contiguous to that is the room in which the bottles are filled and packed. Each cork shows the brand of the Metternich arms; after it has been inserted in the bottle, it is sealed over, and the wax is again impressed with the same coat of arms. A label stating the name, year, and price of the wine is now fixed upon each bottle; the bottle is wrapped in paper and surrounded with straw. Fifty or a hundred such bottles are now placed in a box and packed very tightly, the packers actually jumping with their feet on the top of the straw in the boxes, and so ramming the bottles down that the spectator is afraid for the safety of the bottles and their precious contents.

The entrance to the main cellar is on the right. This cellar is a great vault, containing upwards of one hundred pieces, in three rows; between the middle row and the two outer rows are two passages of sufficient width to admit of a piece being conveniently rolled through.

The quantity of wine produced varies considerably with the years. Thus, 1817 gave 48; 1818, 47; and 1819, 52 pieces, of wine. In 1831 only 25 pieces were obtained from 43 morgen in active bearing, while in 1833 the same surface yielded 57 pieces. The wines of less good years, and all inferior qualities, are sold immediately after the spring racking, by auction, and only the select qualities are kept in the cellar. At the age of four or five years, the time of their maturity in the cask, they are bottled. The wines after that improve greatly in bouquet, and keep twenty-five years. No doubt a fine bottle of mature Johannisberg Castle is, by the fulness of its taste and the mass of its bouquet, the finest and most powerful drink on earth. A piece of such wine fetches from £500 to £1,000, and in some cases even higher prices have been paid. But the auction wines have nothing like that value, and vary between £50 and £200, according to the qualities which they possess for mixing.

The racking of young wines from rotten grapes is effected by means of air-pressure pumps and hoses, in order to avoid contact with air, which imparts to such wine a dark colour. Such a dark colour is a great objection to Rhine wine, as it produces the suspicion, only too well founded in the case of many dark-coloured wines, that it is an artificial product. The finest Rhine wines are therefore always kept very pale, and any operation which would destroy this peculiarity, even if it would be otherwise innocent and beneficial, is carefully avoided.

To the east of—and almost at the same elevation as—Johannisberg Castle, is the property of M. Mumm, a well-known wine-merchant of Frankfort, consisting of a fine house and large vineyards, with easterly exposure.

The western side of the Johannisberg passes into a mountain side of 20° inclination, which leads to the village of Johannisberg, situated about a quarter of a mile to the north from the castle. Yet this exposure gives good wine. To the north of this village is a somewhat higher hill, with a hollow on its plateau, called the "Johannisberger Höhle." Very good wine is here produced, which would rival the Johannisberg Castle, if it had the same antecedents of cultivation and preparation. But the entire hollow is divided into a large number of small holdings, which prevents all selection, and thus causes an annual loss of good wine to the œnophilists, while the proprietors get much less than they might.

Still more to the north, in the side of the actual mountain, some enterprising people have dug a hole of 12 morgen out of the mere rock, surrounded it with a great wall after the pattern of the Steinberg, and covered it with three feet of earth brought up from the valley, or down from the mountain. This enterprise took ten years, and vast sums for its completion. We have learned no particulars about the wines which it produces, and surmise that they are of the quality of the wines of the village, and go with the general throng of Johannisberg wines into the cellars of knowing and the stomachs of enthusiastic people. It is, perhaps, owing to its excavated origin that the plantation has been termed "the Dachsberg."

GEISENHEIM.

From the Johannisberg towards Geisenheim extends a declivity with southerly exposition, the best situations of which are termed "Morschberg," "Lickerstein," and "Hoher Rech." Near Geisenheim the "Rothe Berg" or red hill projects, much like the Johannisberg. It has the general geological conformation of all similar hills, consisting of clay-schist, and being covered on the east by loam, on the western declivity by red clay. Its inclination is about 20°. The majority of the vineyards belong to Count Ingelheim.

The products of the various parts of the "Rothe Berg" are very varying in quality. The southerly and south-westerly side of the hill produce splendid wine, while at the foot of the north-west side, within a few hundred steps of the former, there is a vineyard which yields the worst wine of the whole district. On the plateau of the hill there also grows but inferior wine.

The "Rothe Berg" is connected with the district of Rüdesheim by a continued vineyard, situated partly on inclines, partly in flat hollows. One of the latter, the "Kirchgrübe," is reputed to be a good situation.

RÜDESHEIM.

The vineyards of Rüdesheim begin at Eibingen and terminate at the Bingerloch. Their inclination begins to increase from Eibingen, where they have 10°, to the Rüdesheim Berg, where 35° and 40° is the average. The exposure is purely southerly; on the north they are protected from winds by the high mountains behind, and the westerly winds are broken by the mountains on the other side of the Nahe. The direct rays of the sun fall almost at right angles upon the soil, and the heat is increased by the reflection from the broad surface of the river.

The vineyards nearest to Eibingen are called the "Wüste," "Bokhaus," and "Tafel," the higher situation towards the forest in the north, the "Oberfeld." All these are planted with the Riessling.

The vineyards nearest to Rüdesheim are termed "Hinterhaus," or "behind the house," have a purely southerly exposure, and are built up in many terraces, with an average inclination of 20°. The contiguous "Rottland" is a more undulating territory, with many little bogs, hollows, and terraces. These vineyards appear from a distance like a gigantic staircase; they are planted with Riessling.

The greater part of the Rüdesheim vineyards is called the "Rüdesheimer Berg." This has an area of upwards of 400 morgen, an inclination of from 30° to 36° southerly exposure, and is the best situation in Rüdesheim. The soil is the disintegrated clay-schist, with a little earth, and the vineyards look so stony that one does not comprehend however the vines exist and luxuriate. The stones are thrown upon heaps in many places, and long so-called stone-rossels, or cairns, run from the top to the bottom of the mountain. The best parts of the Berg are those situated between the middle of the declivity and the border of the river. The Nassau Government planted some vineyards here at great expense, and Count Ingelheim possesses the vineyard termed the "Katerloch." The mere plantation of a morgen of vineyard, with the grubbing and removal of the stones, costs from £600 to £700. As many as 7,000 cart-loads of stones have now and then been built up into cairns, or removed, to make room for the vines. Whatever may be the quality of the vine, it is certain that cheap wine cannot be obtained from vineyards the plantation and cultivation of which is so difficult and expensive. At the old castle of Ehrenfels, which is a conspicuous ruin just above the Bingerloch, the inclination of the territory is 70°. This is the highest inclination of any vineyard in Germany, and equalled only by the steep inclines at Winningen on the Moselle, at Besigheim upon the Neckar, and at Werthheim upon the Maine. Of course this inclination has to be broken by many terrace-walls of from 12 to 20 feet in height, and the earth above these walls has only 20° to 25° inclination.

The entire Berg is traversed by a gradually-ascending carriage-road, which has bays for turning or siding every 300 paces. This road is kept in order by the proprietors abutting upon it, and is cleared, smoothed, and repaired every autumn just before the harvest.

The vines cultivated on the Berg are Riessling, with a sprinkling of Orleans. The plantation of the latter is ascribed to Charlemagne, who, so goes the fable, on seeing from his castle at Ingelheim, on a March day, the snow disappearing from the Rüdesheimer Berg, while the rest of the country all round remained yet white, ordered vines to be brought from the south of France and to be planted on the Berg. It is, however, more probable that this particular Orleans or Hartheinsch was selected for this stony soil on account of its great vegetating power.

ASSMANNSHAUSEN.

This is the "ultima Thule" of the Rheingau, of which it yet preserves the general type, but changed in various particulars. The vines are grown somewhat higher, reminding of the Moselle, where the high cultivation is carried to an unfortunate excess. The set of vines is of a more mixed character, the vineyards for white wine being planted with the small-berried Elbling, mixed with Trollinger and Välteliner, those for red wine with the great black Burgundy grape, the *pineau noir*.

The generality of the Assmannshausen vineyards has a westerly aspect; one particular section, however, which is situated in a narrow valley running from east to west, the Höllenberg, has a number of southerly exposures. This entire situation was a Nassau domain, but the upper part of twenty-seven morgen was sold to Count Bassenheim, while the Nassau Government only retained the lower and best part of eighteen morgen.

The soil is throughout decayed clay-schist, and very stony. The plantations are difficult, and require many walls and great labour.

The white wine of Assmannshausen has no particular qualities or reputation. It is, however, otherwise with the red wine, which has acquired somewhat of a name. We will therefore consider its preparation a little more in detail, in order to appreciate the better its deficiencies and good qualities.

The private proprietors proceed in the following manner. They crush the grapes with wooden clubs, and then put the entire mass into vats. Many such vats are made of piece casks cut in two through the middle, or entire piece casks from which the top has been removed. During the first violent fermentation the rising husks and stalks are pushed down about twice every day, at a later period once daily.

When the fermentation is complete, the wine is drawn off, the residue put into the press, and all fluid is united.

The stewards of the Nassau domains, however, observe greater precautions. In the first instance the grapes are allowed to hang until they begin to shrivel a little, but they are not permitted to get rotten; for, although this might make the wine more sweet and spirituous, yet it would deteriorate its colour, and therefore one of its main characteristics. All rotten grapes are therefore carefully kept out of the vintage. The grapes are carried to Rüdesheim and there treated as follows:—The berries are separated from the stalks, by being stirred about with a stiff broom in a sieve of iron wire placed over a vat. They are then trodden in detail by men with wine-boots, or pounded with wooden clubs, until reduced to a pasty mass. This mass is then put into the fermenting vats. The wine rises nearly to the top, but the husks are kept in the fluid by a perforated wooden diaphragm, which is fixed in the upper third of the vat. After fermentation the wine is drawn off through the tap at the bottom, which is guarded inside by a strainer; the husks are pressed, and the pressed wine united with the previously drawn wine. This red wine is mostly kept in smaller casks of two and four ohms each; it is racked from the lees in March, and, after four or six weeks of rest, sold by auction.

The banks of the Rhine from Assmannshausen to Coblentz have many vineyards, but no very good situations. Amongst the villages which produce wine is Bacharach. In this village there was an interesting little inn "To the golden cork-screw," where good wine was sold. Some travelling artists of Düsseldorff commemorated their approval of the wine which was served to them, by painting a great and showy shield in oil colours upon the wall of the principal wine-room. The names of other villages producing some wine are Manubach, Caub, Oberwesel (celebrated amongst Rhine-tourists by its echo), Steeg, Diebach, Weinsberg, Damscheid, Perscheid, Langscheid, and Dellhofen. These cultivate Riessling, often mixed with the small-berried Elbling (Lorch has Elbling only): in other parts some Pineau is grown.

AREA OF VINEYARDS IN BEARING IN THE FORMER DUCHY, NOW PRUSSIAN PROVINCE, OF NASSAU.

The areas are here given in old Nassau "morgen," containing each 160 square "ruthen" (or Nassau roods). The present Nassau land measure is a morgen, of 100 ruthen of 100 square feet each, equal therefore to 10,000 feet = 2,500 square mètres, or 25 French ares. (Law of Dec. 12, 1851, and March 18, 1853.)

I. AMT OF BRAUBACH.

	Morgen.	Ruthen.
Braubach	215	154
Camp	354	89
Filsen	38	40
Nieder-Lahnstein	191	134
Nievern	63	95
Ober-Lahnstein	207	159
Osterspay	78	61
	1,141	92

II. AMT ELTVILLE OR ELLFELD.

	Morgen.	Ruthen.
Eltville (Ellfeld)	469	126
Erbach	377	60
Hallgarten	280	122
Hattenheim	368	128
Kiedrich	223	95
Mittelheim	211	52
Neudorf	173	63
Nieder-Walluf	118	72
Ober-Walluf	38	57
Oestrich	539	104
Rauenthal	265	53
	3,066	132

III. AMT ST. GOARSHAUSEN.

	Morgen.	Ruthen.
Bornich	115	81
Caub	303	10
Dörscheid	55	44
Ehrenthal	28	155
St. Goarshausen	173	15
Carried forward	675	145

AMT ST. GOARSHAUSEN, *contd.*

	Morgen.	Ruthen.
Brought forward	675	145
Lierschied	33	76
Nieder & Ober-Kestert	124	81
Nochern	42	10
Patersberg	35	98
Wellmich	64	25
	975	115

IV. AMT HOCHHEIM.

	Morgen.	Ruthen.
Delkenheim	66	112
Diedenbergen	75	156
Flörsheim	259	55
Hochheim	904	97
Igstadt	41	3
Massenheim	69	98
Nordenstadt	86	75
Wallau	83	126
Wicker	196	128
	1,779	50

V. AMT HÖCHST.

	Morgen.	Ruthen.
Hofheim	80	86

VI. AMT NASSAU.

	Morgen.	Ruthen.
Bad Ems	39	44
Dausenau	79	51
Dinunthal	8	157
Nassau	109	96
Carried forward	237	28

AMT NASSAU, *continued.*

	Morgen.	Ruthen.
Brought forward	237	28
Obernhof	41	47
Scheuern	17	151
Weinähr	23	131
	320	37

VII. AMT RÜDESHEIM.

	Morgen.	Ruthen.
Assmannshausen	204	65
Aulhausen	22	42
Eibingen	249	113
Geisenheim	627	70
Johannisberg	226	60
Lorch	544	5
Lorchhausen	196	135
Rüdesheim	567	70
Winkel	493	68
	3,140	148

VIII. AMT RUNKEL.

	Morgen.	Ruthen.
Runkel	23	54
Schadeck	14	94
Villmar	4	159
	42	147

IX. AMT WIESBADEN.

	Morgen.	Ruthen.
Frauenstein	126	93
Schierstein	166	46
Wiesbaden	47	92
	340	71

X. AMT KÖNIGSTEIN.

	Morgen.	Ruthen.
Altenhain, Neuenhain	86	—

RECAPITULATION.

	Morgen.	Ruthen.
Braubach	1,141	92
Eltville (Ellfeld)	3,066	132
St. Goarshausen	975	115
Hochheim	1,779	50
Höchst	80	86
Nassau	320	37
Rüdesheim	3,140	148
Runkel	42	147
Wiesbaden	340	71
Königstein	86	—
Total	10,974	78

Tabular View of the Proportion in per cents. which the Vines planted in the Ten Divisions of Nassau bear to each other.

No.	Names of Aemter.	Riess-ling.	Orleans.	Trami-ner.	Oester-reicher.	Klein-berger.	Mixed vines.	Pineau Klebroth.	Early Bur-gundy.
1.	Eltville . .	92·8	—	0·8	5·2	0·1	0·5	0·2	0·4
2.	Rüdesheim .	42·4	2·4	4·1	1·9	5·4	39·5	4·1	0·2
3.	Hochheim .	66·2	—	3·1	30·1	—	0·4	0·1	0·1
4.	Wiesbaden .	69·6	—	1·4	17·5	—	10·7	—	0·8
5.	Runkel . .	—	—	—	—	—	—	100·0	—
6.	Nassau . .	3·7	—	—	—	25·1	9·7	59·1	2·4
7.	Braubach . .	1·6	0·1	1·4	3·8	66·8	11·5	3·6	11·2
8.	St. Goarshn. .	2·4	—	0·5	17·8	62·9	15·2	1·1	0·1
9.	Höchst . .	10·9	—	—	86·5	—	—	—	2·6
10.	Königstein .	46·5	1·2	—	23·3	—	17·4	—	11·6
	Total Nassau .	50·9	0·8	2·2	8·9	16·3	16·9	2·5	1·5

RHENISH MEASURES OF CAPACITY.

The new (1851) Nassau ohm is 160 litres; the piece "Stück" is 7½ ohms, or 1,200 litres; the same measures for wine obtain in Hesse Darmstadt and Baden. The Frankfort ohm, however, by which wine is commonly sold to England, is only 143·41 litres, or 31·56 imperial gallons. Eight ohms equal to one Stück, equal to 1,152 litres (calcul. 1147·28) equal to 640 Frankfort maas. The Palatinate fuder is 1000 litres. There are no barrels of that capacity in use, but sales are generally made at per fuder, as the stores are mostly kept in very large casks.

THE WINES OF THE MOSELLE.

Topography.—The Moselle issues from the western slopes of the Vosges, and unites with the Saar near Trier. It then runs nearly northward with many windings, and flows into the Rhine near Coblentz. Its valley is deeply cut through the Hundsrück mountain on the right, and the Eifel on the left bank. Its undulating banks in Lorraine, like those of the Saar, are mostly covered with vines, and, as we learned from ocular inspection, most frequently with the blue Burgundy grape; but that part of its bank from Trier to Cochem mostly bears white grapes. The valley of this river forms an immense contrast to the high plateaux on both sides of it. These latter are mostly cold and sterile, and covered only by a vegetation of stunted growth. The banks of the valley are rich green, and have a mild climate, and all southerly exposures are covered with the vine. The depth of this valley is from 200 to 300 feet, and the rocks frequently come so near to the edge of the water, that there is not even a path left by the side of it, and the only communication up and down the river is in many parts the river itself. In consequence of this narrowness, many of the towns, such as Cochem, are nothing but long strips of houses built along the water's edge. Wherever a little river flows from the side into the Moselle, a small town or village is sure to be found.

The exposures favourable to the growth of the vine are mostly produced by the long windings of the river which it makes from west to east and from east to west, the expanse of which can be estimated from the following consideration. From Trier to Coblentz the distance in a straight line is about ninety English miles, while the windings of the river are nearly double that length. The bend which the Moselle makes at Graach and Zeltingen affords a southerly exposure of three miles in length on the left bank.

The southerly exposure at the bend at Piesport and Brauneberg is a mile and a half in length, and situated on the left bank of the Moselle. All banks which have a northerly exposure are covered with forest, which gives to the river this peculiar character—that forest and vineyard are frequently close together, and frequently alternate the one with the other. The inclinations of the vineyards along the whole river are very steep, changing between 20° and 40°. They are least considerable at Piesport, but at Brauneberg they amount to 30°, until at Winningen they reach to 45° and upwards. This latter place is the last in the direction of Coblentz. The vineyards of Winningen rise immediately from the river to a height of about 300 feet. They are interrupted by many terraces and by large blocks of rock, and present such a peculiarly wild aspect, that the spectator hardly comprehends how the cultivators of the vine could dig the ground, bring up the earth, and carry the manure. We learn that these vineyards are real productions of art, inasmuch as they were the result of blasting operations carried out at the instance of the community of Winningen, by engineer officers of the garrison of Coblentz.

The foundation of the soil in the whole of the Moselle valley from Trier to Coblentz is a kind of clay schist of bluish grey, greenish black, and reddish colour. The rock is frequently permeated by veins of white quartz. In many parts the schist is transformed into the black slate here called "lay," with which all buildings without exception along the Moselle are covered.

The cultivated soil itself consists of disintegrated clay schist with many fragments of quartz. The fragments are sometimes rolled by river action, and then the soil of the vineyards resembles to some extent that which one so frequently sees in the Médoc.

VARIETIES OF VINES AND MODES OF CULTIVATION PREVAILING ALONG THE MOSELLE.

Along the banks of the river, frequently twining round trees, there are many varieties of wild vines, probably indigenous to the part where they grow. Of the cultivated varieties, however, only one seems to be indigenous to the Moselle, and that is the *albuelis* of Columella, or *Elbling* or Kleinberger, which is reported to have been carried by Ausonius to the Gironde, and thence by Pedro Ximenes to Xeres, so that (what perhaps no one who drank them side by side would ever guess), Moselle and Sherry wines are to some extent made of one and the same grape. The Elbling occurs along the whole Moselle, and frequently prevails over the Riessling, but the Riessling is everywhere mixed with it. At Piesport, Brauneberg, Oligsburg, Zeltingen, and Trarbach, there are vineyards with nothing but Riessling. Of this vine there are said to occur two varieties in these parts, one with red, the other with green stalks. Here and there along the Moselle are vineyards with the Burgundy grape. At Piesport and Kersten more red wine is already made, and in the neighbourhood of Cobern, Cochem, Carden, and a few other places of the lower Moselle, much red wine is grown, so that the Burgundy grape can be said to be the prevailing kind.

FIG. 79.—Vine trained according to the method recently adopted in Lorraine, in full bearing. All branches are lopped off two joints above the last bunch. No long canes are allowed to grow. (Système Trouilles.)

The dressing of the vine offers many peculiarities along the Moselle. There are on the steep inclines many vineyards belonging to poor people, which are cultivated upon the so-called "hedge" principle; that is to say, the vines are cut, but for the rest they are allowed to lie on the ground, and to grow as best they may. The produce of these vineyards is not of sufficient value to pay the cost of cultivation, including sticks for supporting the vines; but the better cultivated vineyards offer a singular aspect, which is not frequently met with in any other vine-growing country. They have more the appearance of hop-gardens than of vineyards. Around an enormous pole fixed in the ground from four to eight canes are attached in the manner in which birch is fixed to a broom. The canes are bent backwards and downwards at three different places, being two, three, and four feet above the ground. In fact, as much wood as the vine can produce is left upon the vine; and there have been instances where a cultivator has dismissed his vine-dressers because they did not leave enough wood to satisfy his greed for quantity of produce. Now, it is very well known that the nearer a vine grows to the ground the better its grapes will mature and the more developed they

FIG. 80.—Vine pruned according to the method recently adopted in Lorraine. The pruning in the Hérault, Aude, and Lot is exactly the same, but the summer dressing is different.

will become, and that the higher it rises above the ground the more it is exposed to the winds, and the less it is struck by the radiating heat which is rebounded from the soil, and consequently the more its grapes are liable not to ripen at all, but to remain acid and useless fruit. It is this attention to low cultivation—to the keeping of the grape in the closest proximity to the soil—which produces the excellence of the wines of the Rheingau, of the Médoc, and of the Champagne.

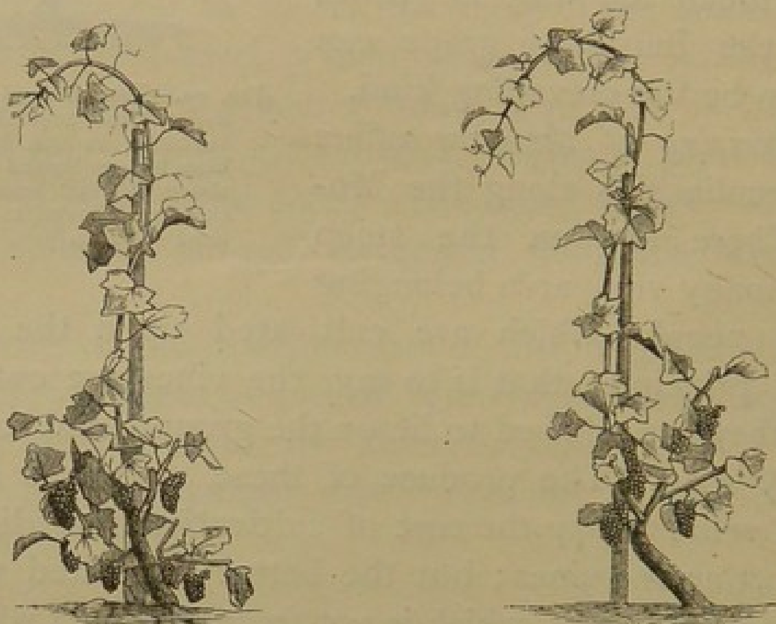


FIG. 81.—*Right*, A vine as grown at Pagny in the Meurthe (Department of the Moselle): one fruit-branch and one wood-branch only. *Left*, Vine with one bent cane for fruit, and a spur for wood, as grown at Pagny.

But here on the Moselle this experience is in many parts completely set aside, and accordingly we find the produce of this particular cultivation to yield sour, thin, and tasteless wine. We are aware that there are single proprietors who cultivate their vineyards upon the best principles recognized along the Rhine, but they are few and far between. There is no doubt that the production of the wine along the Moselle could be frequently improved by the adoption of better methods of cultivation.

THE VINTAGE.

There has hitherto been along the Moselle the old detrimental vintage ban. The town or village council determined the time at which the vintage should begin and cease. There was no selection of grapes, no removal of unripe or rotten berries. The grapes were crushed in the vineyards in pails and other vessels, carried home, and allowed to stand until they could be pressed. The must was then fermented in the usual way.

CHARACTERS OF MOSELLE WINE.

The general character of Moselle wine is that of thin Rhine wine, but it never has as much flavour as even the thinnest of those wines. It matures quickly, and does not possess the keeping qualities of Rhine wine. Owing to the natural want of flavour the producers of Moselle and the merchants in their track have devised an artificial flavour, which imitates to a certain extent the flavour of wine made from the muscatel grape. This is the tincture of the flowers of the elder shrub. Of this tincture, or "Essence of Muscatel," large quantities are annually made along the Rhine and Moselle, and used for the production of the peculiar bouquet, particularly in "Sparkling Moselle." The tincture is made as follows: The little elder flowers are cut from the bunches and infused with pure strong spirit of wine. After twenty-four hours' standing the spirit is drawn off and filtered. It may now again be infused upon new elder-flowers, and this process repeated several times, according to the strength which it is desired to give to the essence. Much care has to be bestowed upon the filtration of the essence to make it clear. Of this tincture a small quantity is added to common Rhine wine or Moselle, whereupon it assumes the peculiar flavour, which anyone conversant with the process of its production recognizes at once. It must be declared with emphasis, that there is not a grape of muscatel grown upon the Moselle fit for wine-making; that there is not a single barrel of wine made there which naturally has the muscatel flavour; and that all the wine having the flavour which imitates it, is made up with tincture of elder-flowers. Much of the tincture is imported as such into England, and there used. Much of the "Moselle with the muscatel flavour" sold in England is Rhine wine flavoured with elder-flowers.

There can be no objection to the use of this tincture, provided that it be known to the consumer that he pays for elder-flower, and not for muscatel. Elder-flower is in no way prejudicial to health, and has from time immemorial been used to make a high-flavoured tea for the treatment of slight indispositions.

It is a singular circumstance that with such a cultivation of the vine as we have above seen, and with the production thereby of such a mass of undrinkable liquid, the Moselle should nevertheless have obtained the reputation for good wine, and that particularly in England; while in Germany few persons would drink Moselle as a matter of choice, but only as a matter of economy. Some persons no doubt drink Moselle wines from a kind of tradition, which can only have been the result of the importation of wines from a few of the best situations in times gone by. Others drink it at the bidding of their medical advisers, which may be judicious, provided it is based upon better arguments than the recommendation of Dr. Meurer. This author thinks that "the undeniable fact of longevity amongst the inhabitants of the Moselle districts may well be considered a convincing proof of the excellent influence of its wines." Of course this "undeniable fact" is not based upon any statistics, and consequently the impression which the sentence might convey, that the average duration of life amongst the inhabitants of the Moselle valley was longer than elsewhere, would be quite erroneous. But even if it were so, new proof would be required to show that this had any connection whatever with wine drinking. No such proof has been furnished by the doctor, and we venture to believe will never be forthcoming. Having assured us that "stone and similar diseases" are entirely unknown in the Moselle district, Dr. Meurer maintains that they could be cured by

Moselle wine. For the floating of this assertion he evidently calculated upon the lay public, for every medical reader would repudiate it, and declare it a baseless absurdity.

Excluding, then, from our estimate of the Moselle wines all exaggeration of enthusiasts and vendors, we may state them to be, in their natural state, and when of good years and situations, mildly flavoured, acidulous, refreshing drinks, which owing to their low alcoholicity may be taken freely, and will increase the appetite, stimulate the kidneys, and exhilarate the senses without heating blood or brain. This applies to wines not possessing the muscatel flavour, for the addition of this in the shape of elder-flower tincture involves an increase in the alcoholicity. However small that may be, it has to be taken account of.

We should value Moselle wines still higher for use in Great Britain, if they were offered to us at anything like their natural price. But they are sold with an affectation of value, which places them as high as Rhine wine, and which forbids every extension of consumption amongst the middle classes.

The Sparkling Moselle has a great reputation. Its flavour is more frequently derived from the elder-flower than from the œnanthe. Much of it is made at Coblentz, and large quantities are also manufactured from Rhine wine at Mayence. It is agreeable and acceptable to many. The analysis of a specimen of it by Mohr, obtained from the manufactory of Deinhardt of Coblentz, has been stated on p. 486.

AREA OF THE VINEYARDS IN THE PROVINCE OF RHENISH PRUSSIA.

Governmental Department.		No. of Morgen.	Totals.
Aix . . .	On the Roer . .	119	
			119
Coblentz . .	On the Rhine . .	11,844	
	„ Moselle .	8,947	
	„ Ahr . .	3,256	
	„ Nahe . .	6,666	
			30,713
Cologne . .	On the Rhine . .	3,236	
	„ Sieg . .	108	
	„ Erft . .	1	
			3,345
Trier . . .	On the Moselle .	11,659	
	„ Saar . .	2,339	
	„ Saur . .	39	
	„ Nied . .	403	
	„ Rims & Our	14	
			14,454
		Total	48,631
	Of which there are on the Moselle		20,606
	„ „ „ Rhine		15,080

CHAPTER XVIII.

THE WINES OF AUSTRIA.

THE WINES OF LOWER AUSTRIA: Wines of Kloster Neuburg.—Red wines of Vöslau near Vienna. WINES AND GRAPES OF TYROL: Topography.—Varieties of cultivation, Italian and German.—Varieties of vines.—Vinification.—No Traminer at Tramin.—Tyrolese apples.—The grape-cure at Meran. WINES OF STYRIA: Introduction.—Topography.—Climatic condition.—Social condition of Styria as influencing viticulture.—Soil.—Varieties of vines cultivated.—Mode of planting and cultivating vines.—Vinification in Styria.—Pressing in Styria; German, wendish.—Statistics and nature of the wine produced. WINES OF CROATIA: Introduction.—Climate, soil, labour.—Prevailing vines.—Mode of cultivation.—Vintage, cellars, wine.—Exhibition of wines at Agram in 1864. WINES OF DALMATIA: Topography.—A traveller's route.—Vineyards.—Cultivation.—Varieties of vines.—Maraschino wine different from liqueur.—Vintage and vinification.—Wines.—Sale, value and export of wines. WINES OF ISTRIA: Topography.—Viticulture at Trieste, Italian.—Garland, bower, and chamber cultivation.—Varieties of vines.—Vinification.—Viticulture important to shipping.—Piccolo or Hansel. WINES OF GÖRTZ: Farming at wine rent.—Effervescent wine from the "ribola"grape.—Picolit, sweet wine. WINES OF BOHEMIA.

WINES OF LOWER AUSTRIA.

WINES OF KLOSTER NEUBURG.

IN German Austria the young wine is put into professedly new barrels of very large size, the man-hole doors of which are not pierced. The wine is not drawn from the lees in spring, but is allowed to remain with them until sold and broken. The purchasers do not like to buy casks which have the man-hole doors pierced, from the belief that such a condition of the cask would indicate that the wine had been tampered with. The producers know very well how to avoid this suspicion by providing every old cask which they use for receiving new wine, or any wine in their cellars, with a new man-hole door which has not been pierced. At the Convent of Neuburg, near Vienna, there are in three cellars, one above the other, a great number of casks of wine containing up to ten fuder. One fuder is equal to thirty-two eimer, or about 1,728 litres. These casks are full of wine, and have no tap-holes, and, although filled ten years and longer, yet contain the first lees. In the year 1840 Bronner tasted wine at Neuburg which had been put into the barrel in the year 1822, and not been racked at all. The Austrian viticulturists maintain that wine so kept preserves more of its freshness than if it were racked. We, however, who have had opportunities of tasting a great many Hungarian wines, and wines from the Convent of Neuburg, maintain that this practice will go a long way to explain the shortcomings which almost every wine of Austria carries with it to England.

THE RED WINE OF VÖSLAU, NEAR VIENNA.

Two viticultural districts—those of Vöslau and Gumpoldskirchen, in the neighbourhood of Baden, about fifteen English miles south of Vienna—have, during the last thirty or forty years, obtained some notoriety. The red wine produced in them comes from a particular black grape, called the early blue Portuguese. This is an early ripening, very sweet grape, of somewhat larger size than the Burgundy, and is very much esteemed as an eating grape, on account of its agreeable taste. When properly matured it is bluish-black, and gives a wine of dark colour. It is said to have been imported from Portugal, but we have not been in any way able to substantiate this assertion by positive proofs. The leaf of the vine is five-lobed; the lobes are not deeply cut out; the upper surface of the leaf is shiny; the lower one is smooth, and without any covering. The production of this red wine was a great success in Austria, inasmuch as in the other parts of that empire very little red wine is produced. The cultivation of the grape spread during the last thirty or forty years over a large area. The wines are tolerably well paid for, and reward the producer by their quality of being fit for use in a very short time after they are made, and not requiring a long sojourn in the cellar, an advantage mainly due to the sweet and mild quality of the grape. The other wines of Austria require to be kept from eight to ten years in barrel before they become drinkable.

The produce of Vöslau is mostly bought by the innkeepers and speculators of Vienna and Baden, in the shape of what is called "*gemesch*," that is to say, of grapes in a vat crushed by means of wooden stampers. It is difficult to say what process these speculators carry on in order to produce the wine. In some parts of the district where there are larger proprietors, the ordinary methods of separating the berries, crushing them, putting them in vats, drawing the wine at the proper period, and pressing the murk which we know to prevail in Burgundy, the Gironde, and on the Rhine, are practised.

The vine is trained upon a system called head system. The heads are about five or six inches above ground, and of the size of a fist, or twice as large. From four to six shoots are left every year to ripen, and the remainder are broken off. In spring the wood is cut down to one eye. The only advantage of this practice is that the grapes are kept very near the ground, but they are also kept very small, inasmuch as the eyes which are nearest the old wood always produce the smallest grapes, while the second or third eye—the highest eye of the spur—always produces the largest. This mode of cultivation, therefore, produces too much wood and too many leaves, and, although it may produce many, it yields but small grapes. From Vöslau these Portuguese vines were transplanted to other parts of Germany, and in many parts of the Würtemberg Alps very successful plantations have been effected. The wine obtained there preserves the qualities of the Vöslauer, namely, those of being of a very dark colour, smooth to the taste through the absence of tannin, and very soon fit for use. The soil of Vöslau is chalky, and the earth of the vineyards contains many pieces of the chalk rock underneath, in the form of stones.

WINES AND GRAPES OF THE TYROL.

Topography.—Varieties of cultivation, Italian and German.—Varieties of vines. —Vinification.—No Traminer at Tramin.—Tyrolese apples.—The grape-cure at Meran.

TOPOGRAPHY.

The Tyrol is of interest to physicians as well as the general public, for here are produced not only good wines but also grapes, which are used as medical agents for the treatment or cure of many ailments. That part of the Tyrol which produces wine is situated along the valley of the Adige, beginning near Verona, and running by Botzen up to Meran. All the slopes of the hills and debouchments of the lateral valleys are employed for that purpose. The valley of the Adige is protected towards the north by high mountains, and represents a kind of basin, over which eastern or western storms have no power, and the slopes of which are most favourable to viticulture. In the bottom of the valley there is a deep loamy alluvial soil. The slopes, where they are not too much inclined, are covered by a fertile somewhat stony soil, being a mixture of chalk, gneiss, and porphyry. Porphyry soil is preferred for viticulture. Soil, climate, the precipitation of moisture in clear nights, and rains at the proper seasons, unite to produce one of the most splendid vegetations that can be imagined. At Botzen and Meran it may be said that sun and moisture vie in producing the greatest development of the vegetable kingdom compatible with a temperature of the moderate zone. If the traveller ascends the valley of the Adige, he finds that with the Italian language ends the Italian method of viticulture. With the German language which he encounters at Tramin and Neurmarkt, the system called bowers commences, while that of the Italian garlands ceases. For some miles both systems are intermixed, imitating the mixture of the nationalities. The training of the vines on trees continues up to Roveredo. Hence appear the crossed stakes, which we shall describe when speaking of Trieste. The garlands are trained nearer the ground, and the plants close together. At last there are no more twisted ropes or canes, but only single canes stretching from one stake to the other, and further on low frames appear until they are met with only in single rows, between the

FIG. 82.—*Left*, Vine trained and pruned in the shape called "horns." *Right*, Vine trained and pruned to the shape called "head-knob," or "willow-tree top." Common in Switzerland and Savoy. (Size one-fifteenth of nature.)

ordinary fields. The more nearly the valley approaches the forest regions of the mountains, the more wood is employed in the construction of frames. At Tramin, at last, there is nothing seen but the pure bowers, which remain the same to the northern frontiers of the Tyrol, Meran and Brixen.

FIG. 83.—View of vines trained and cut to the shape called "head-knob," in full bearing, as seen at Seyssel, Switzerland. (Size reduced to one-thirtythird of nature.)

This bower training has some advantages. A great quantity of wine of the lowest quality is thereby produced. The proprietor is enabled to till his soil under the shadow of his vine during the hottest part of the day, and to grow carrots, cabbages, peas, and whatever else will consent to grow under such conditions. In some we have even seen grass and clover. In the neighbourhood of Botzen the proprietors have begun to abandon this method, and have commenced the system of closed vineyards with low plants trained to stakes in the manner of the Rhenish cultivation. These proprietors are all Germans, who cultivate busily, break off the superabundant branches, tie up, and thereby produce better growths; whereas the Italian vines are always left to themselves, and constantly give to the spectator the impression of wild plants. The varieties of the grapes cultivated in the Tyrol are in the Italian part entirely Italian: in the German part there have hitherto been only large-berried white and blue varieties —among them the Vernatsch. This is a black muscatel, and as such is known in France and Germany. It occurs also under the name of Aleatico; but in Upper Italy it is known under the name of Vernaculo e Toscana. It has also been termed red Frontignac. This is a tolerably good grape for eating, but requires a very warm climate for ripening, and then produces sugary wines, with the muscatel flavour,— in fact, Frontignac; but for the production of dry wines, for which it is used in the Tyrol, it is quite unsuitable. Then there is another variety, which the Germans call Geschlafene. And lastly, there is that celebrated, and to all growers of vines in hot-houses, and particularly therefore to English viticulturists, most important vine, which they know under the name of the blue or black Hambro', known in Germany under a variety of names, but most commonly under that of Tirolinger, or the abbreviated Trollinger. The French, who received it from the Palatinate, call it Frankenthal. This is of all eating grapes the most perfect, on account of its having thin husks, small pips, tolerably solid yet juicy flesh, and an agreeable acidity never in excess, mixed with a sufficient amount of sugar, and mild flavour. The bunches are never very large, and not so close that the grapes have not sufficient space to develop themselves. The vine is always fertile, and even in bad years its fruit may be used, though not completely ripe, on account of the moderate amount of acidity. When the grape gets ripe and is allowed to hang a little beyond its actual period of ripeness, it yields a splendid wine. We hold this variety of grape to be indigenous, and particular to the Tyrol. In no vineyard in France have we met with it as the predominating vine, but it occurs in Italy, and very commonly in the south of Germany, where, particularly in some districts of Würtemberg, it predominates in vineyards with a chalky soil. No doubt it migrated there from the Tyrol. Styria and the rest of Austria seem not to cultivate this fertile plant. In parenthesis we will mention that there are two celebrated vines of this variety—one in a greenhouse in Hampton Court Gardens, and one in the conservatory at Windsor Castle. These should be visited towards autumn, by any one who wants to see the immense fertility of this vine.

VINIFICATION.

The Tyrol wine is made with much more care in the German than in the Italian district. The mash is put into the vat and covered with a circular board, which is then luted down by means of loam, so that the hat of the murk is always kept in an atmosphere of carbonic acid. The white wine is mostly made after the red. The must pressed from the white grapes is thrown on the murk left in the vat after the red wine has been drawn off, whereby a pale red wine which is used for dinner is obtained. This wine, owing to its pale red colour, is called Schilcher. The treatment of the wine in the cellars is pretty perfect, and the wines which one obtains when going through the country are free from those faults and bad tastes which the wines of Dalmatia, Croatia, Istria, and the Italian part of the Tyrol and Venetia, always show. In these parts there has now begun a movement for the production of good wines upon the German principle, and several viticulturists—Sallinger and Bauer, and others—have planted vineyards with the best vines of the Rheingau. The year 1864 ripened the first fruit; and although it was a very bad year, the Riessling and Traminer became ripe in a manner which very rarely is attained on the Rhine. While, however, the growing of the vines is a perfect success, the treatment of their wines has yet to be learnt by these proprietors. Those which we tasted were yet turbid, and not in a condition to be either bottled or sent away. It is believed that, if the Tyrolese learn the treatment of the wine in cellar, they will be able to produce in future qualities which will carry on an easy competition with the produce of other districts. At Botzen a traveller was glad to have placed upon his dinner-table, as a matter of course, Riessling wine, Botzen growth, but it was not yet brilliant. At Botzen, also, the belief is entertained that the variety of vine which we have described as predominating in the Palatinate—namely, the Traminer—comes from Tramin, and prevails at Tramin. Several viticulturists—such as Bronner, Babo, and others—have been convinced by inspection of the district of Tramin that there is not a single plant found in the whole district, and that there is not even a chance of a vine in the district being mistaken for the Traminer, because the Traminer is pale flesh red or brownish red, while all the vines at Tramin are either black or white. Tyrol is celebrated in Austria and Russia for its produce in fruit. It produces an apple called the white Rosemary apple, which the Russian traders buy, if it is fine, at the price of a shilling a-piece. The red Rosemary and white Calville, which are much better apples than the white Rosemary, do not obtain a quarter of that price. It is a fancy fashion of the Russian dinner-tables to have this white Rosemary, and the people therefore treat these apples with more care than they would bestow on eggs.

THE GRAPE CURE AT MERAN.

We adopt the term "grape cure" as being commonly understood, though we have particular objections to its implied significance. It signifies the systematic eating of grapes on the part of patients afflicted with sundry chronic ailments which resist the ordinary modes of medical treatment, for the purpose of ameliorating these ailments. There are at Meran lodging-houses and hotels where, at the proper season, people from many parts of Europe arrive and put themselves under the care of those medical practitioners who make a speciality of this kind of treatment. The patients are made to eat grapes in considerable quantities frequently during the day, the largest quantity in the morning, and at the same time to take exercise. To the greater number of these patients the eating of grapes is more a pleasure than a sacrifice. The earliest effect is purgation; but as the grape-juice nourishes at the same time, it is superior to the mere purging mineral waters, provided, of course, that the grapes used for the treatment are properly selected. This does not always seem to be the case at Meran, for there is nothing to be had there except the Trollinger, in a condition in which it is still watery and acidulous, and the Vernatsche, *i.e.* Veronaccia, or vine of Verona, there called Pavana, being also at the early season, when the cure must be commenced, not sufficiently advanced in sweetness and concentration. The medical practitioners of Meran have recognized the disadvantage of having no choice except those two varieties, and have even observed that at some periods their patients rather lost than gained weight; while in the establishments for the grape cure at Dürkheim in the Palatinate, the patients mostly increase in weight during the treatment. Meran is a climatic place of great reputation in Germany; many people go there in order to ease their phthisical lungs during the winter time. It is therefore to be hoped that there may be found enterprising persons who will supply the want of variety and quality of grapes early as well as late, so that this treatment, which seems to be beneficial in many respects, although not specific in any one, may be carried out to its fullest extent.

THE WINES OF STYRIA.

Introduction.—Topography.—Climatic condition.—Social condition of Styria as influencing viticulture.—Soil.—Varieties of vines cultivated.—Mode of planting and cultivating vines.—Vinification in Styria.—Pressing in Styria; German, Wendish.—Statistics and nature of the wine produced.

TOPOGRAPHY AND SOIL.

Although the viticulture of Styria had been described and discussed by many authors in that country itself, yet it only became known in Europe, particularly in Germany, through the works of Bronner. We must look upon such developments in the light of discoveries, and not conclude that, because the capabilities of production of a land were hitherto unknown, the produce was not of any importance to countries lying at a distance. In the autumn of 1867 we saw in traveling through France railway waggons in the midst of the Champagne, at Boulogne, and at Calais, coming directly from Presburg in Austria, and showing on their German tickets that they had carried grain. We know that much of the grain of Croatia has been shipped at Trieste and carried to England. There is, therefore, no great stretch of the imagination involved in the hope that in the future our great want of wines in England may be in a similar manner alleviated by importations from the Austrian dominions, provided always that the wines are there treated in the manner in which we have shown that wines ought to be treated.

The cultivation of the vine in Styria extends from Steinbrück, along the Save, and from Cilli by Hohennegg, Gonolütz, and Windischfeistritz to Marburg, the vineyards in the mountains called Bacher being particularly extensive. Hence viticulture extends in the direction of Pettau and Fridau, into the most celebrated district, namely the mountain of Luttenberg. Radkersburg and Windisch-büchlen complete the enumeration of the viticultural districts of Styria. The climatic conditions of Styria are very favourable for the production of wines in all those parts which do not rise more than a thousand feet above the sea, and are protected against northerly winds by high mountains. In most parts, however, only medium classes of wine will be produced. Fine wines will probably be out of the question.

The soil is everywhere rich and deep, with vegetation extending from the tops of the mountains to the valleys. Splendid vineyards are nearly everywhere distributed over the whole of the southern part. A more dense agglomeration of vineyards is found in the southern corners of Styria along the Save to the Croatian frontier. Towards the north, the Gallus mountain stretches from Saurisch. The wines of the western part of the Gallus mountain are generally known under the name of the place where they are usually sold; namely, "Saurisch wines." The southern and western slopes of the Bacher mountain may be considered a separate group of vineyards. The greatest extent of viticulture, however, is met with in the low hills of the mountain called Windisch-büchlen. The lowest south-western part of it is the celebrated Luttenberg mountain. Opposite to this, towards the east, there are the Marburg vineyards, and the district is in the north limited by Radkersburg and Leibnitz. On the east and north of Gratz there is little viticulture on account of the high mountains; but the low hills which run eastwards towards Hungary bear, without exception, single vineyards which become very frequent as the valleys approach Hungary, and pass gradually into the celebrated wine-producing district of Güns and Steinamanger. Styria debouches not towards the Mediterranean, or the northern part of the valley of the Danube, but its long-drawn valleys are all directed towards the east and communicate with the lower part of Hungary. As hitherto the only sales could take place in the direction of the rivers, and as just in that direction there was no want, the only market which the Styrian producer had for his wine was in his own land, and in the mountainous districts of the neighbouring Alps. The total production of wine in Styria is carried on upon a surface of 54,000 joch or morgen, each joch carrying 4,000 vines. Red wine is produced in only two parts, the Vinarie mountain near Gonovritz running to Cilli, and in the Sausal mountain. While the districts which we have above mentioned consist of hills, the slopes of which are covered with vines, there are near Pettau ranges of hills—so-called Colles—nearly thirty miles in length, on which viticulture is carried on in the crater of the extinct volcano, of which each hill is the remnant. The reader must imagine a succession of hills running over the area mentioned, all having funnel-shaped excavations at their top. The area of the inside is mostly ten morgen, including the slopes, but there are some where the area rises to twenty morgen. There is access at only one part. The vines are on the southerly and south-easterly and south-westerly slopes. The northerly sides are mostly covered with forest. In the bottom of the crater, which is made rather even by the earth, which has gradually been carried down the sides, ordinary agriculture is carried on, and potatoes, maize, and fodder plants are grown. In the middle of each crater there is a projection, and this has mostly been chosen upon which to build the residence of the viticulturist. The traveller who stands on a high point, and looks over these craters and the little houses projecting from them, particularly when the intervening air is filled with watery vapour, enjoys an apparently magic aspect. The houses appear above the horizon, as if suspended in the heavens, and apparently having no connection with the earth.

SOCIAL CONDITION OF STYRIA AS INFLUENCING VITICULTURE.

Styria is divided into two nearly equal parts by the river Drave, which comes from Carinthia, and runs into the Danube in Hungary. The part of Styria north of this river is entirely German. The part south of it is Wendish. This division is so marked, that in the town of Marburg, everybody on the left bank of the river speaks German, while across the bridge everybody speaks Wendish. It is a singular circumstance that all the Wends are viticulturists, and that the Germans, who are in all other parts of the world very fond of the cultivation of the vine, engage here but little in that occupation. This may, perhaps, have arisen from conquest, the last effects of which, in the shape of serfdom, were only abolished a few years ago.

The wine-producing Wends are termed Weinzettel. They live on small rural properties, where they produce all their wants, wood, fodder, corn, and wine. Some are farmers, and pay rent to the proprietors for the vineyards they cultivate, but the greatest numbers are proprietors of small peasant farms. These farms are mostly rounded off properties, so that the whole complex of the fields lies close together, and the farm-buildings are situated in the middle of it, if possible on an eminence, and, in the case of the volcanic hills which we have already described, in the middle of the crater on the central eminence. In such farm-buildings there are lodgings for a family, and sheds for a few cattle, pigs, and poultry. There are frequently, also, a press and small cellar, and in tenant farms there is a room or two for the proprietor, who comes there for a few days in autumn during the vintage. Where the vine-grower is only a tenant farmer he pays frequently the most curious rents. The master gives him two cows, and finds fodder and straw. The vine-grower takes the grass from the vineyard and feeds the cows with it. The calf of the cow belongs to the master, the milk to the cultivator, but the master frequently exacts eighteen pounds of clarified butter. On the other hand, the master pays to the cultivator thirty shillings per acre in cash, so that there is a perplexing amount of cross calculation. In some parts the dung produced by the cattle on the farm belongs for half the year to the master, and for one other half-year to the cultivator. The system of appurtenances is here carried to an extent which we have never seen anywhere else, and to enumerate all the varieties of emolument which are divided between landlord and cultivator would be impossible. This condition denotes a very low state of society. There is neither capital on the part of the proprietors, nor resource of any kind on the part of the cultivators, and the effect of these circumstances is most painfully discernible in the wine-produce.

SOIL.

The soil in Styria varies greatly; there is tertiary formation, diluvial and alluvial soil of the older period, with fragments of granitic mountains. From Marburg to Pettau along the Drave there is marl; the Colles have mostly clay, which is the produce of recent basaltic eruptions and their disintegration by the atmosphere. In other parts there are conglomerations of chalk containing many shells; at Luttenberg, sandy marl; there is trachyte in other parts, and sandstone forms the basis of the rocks through which the various basaltic and otherwise volcanic eruptions have taken place.

VARIETIES OF VINES CULTIVATED.

In Styria many varieties of vines are cultivated, some of which we are obliged to assume to be indigenous to the soil. In the neighbourhood of the watering-place Tuffer, on the little river San, which runs into the Save, the shrubs along the river are covered with vines, although there is no vineyard within many miles of this place. There are, no doubt, among the other varieties cultivated, Illyrian, Hungarian, a few Italian and French, as well as German vines; but some are quite peculiar to Styria, and these we assume to be indigenous. In the German part of Styria, particularly in the Gratz district, a grape is grown which they call the Bellina. This seems to be identical with what Germans call "Heunisch," which means "Hungarian," and here we observe the curious circumstance that a grape which is grown in Germany and Hungary is by the Germans called Hungarian, and by the Hungarians called German. It reminds one of the instrument used for drawing teeth, which the English call the French key, and the Germans call the English key. In the mountain of Luttenberg, and in the vineyards of the Drave, the Mosler wine predominates, and next to the Bellina it is the commonest grape in all Styria. It also bears the name of Schipon, and we know already that it is identical with the Hungarian Furmint, or vine of Tokay. In bad years this vine gives a bad wine, but on the exposures of the Luttenberg mountain it yields the best wines of Styria which have a reputation dating many centuries back. The Mosler has however this advantage, that it always bears, always ripens its wood, always produces middle-sized grapes, which do not drop easily, and when the sun is high, shrivel into raisins, from which, if need be, sweet wine can be made. In the rest of Styria, in the direction of Croatia and Carinthia, a great variety of vines are cultivated, which there ripen easily. The Riessling has also been transplanted there, and yields a very fiery wine, but it appears to lose its grand flavour. The principal vine there is called Tantowina, which bears immensely, but gives a mediocre wine. Its German name is Mehlweiss. Another variety is the green Hainer. In the mountain of Gams half the vines are of the variety called white or yellow muscatels, the same which give the wines of Frontignan and Lunel in France. It attains moderate sweetness and an agreeable flavour. The wine, however, which is made of it, loses both the sweetness and flavour when fermentation is over, and is therefore always drunk during the state of fermentation. The variety of vine which yields the Gonovitz red wine is the Kauka, a small black round grape of an agreeable and peculiar flavour, with a round three-lobed leaf, which becomes red in autumn. To this vine the people of Gonovitz pay particular attention; they remove the berries from the stalks after having made a careful selection of all the good grapes in fine weather; the grapes are then mashed and fermented in vats. The murk is frequently submerged, and the wine is treated as French red wines are treated. The variety of vine which is most commonly grown in the Sausal mountains is the blue Wildbacher, an abundant bearer, which hardly ever fails. We saw a vine of this kind in the garden of the late G. P. H. Bronner, of Wiesloch, which had been trained on a pear-tree so as to cover it entirely, and which in the year 1866 produced sixty litres of very good red wine. This vine seems to be very well suited for situations where the climate is somewhat rough at times. Its advantages over the Burgundy in that respect are considerable. The wine obtained from this variety is fresh and strong, has body and astringency similar to the wines of

Bordeaux. No doubt it could be kept and transported just as well as the wines of the Palus. The blue Wildbacher is, no doubt, a vine indigenous to the country between Carinthia and Croatia. Its semi-wild character is indicated by its tendency to climb up trees, and in the forests of Carinthia and Styria trees are here and there found covered with it. Its tendency to shoot long canes is very remarkable, some of them being above twenty feet in length. This remarkable plant bears every mode of cutting. It may be trained low like the Burgundy vine ; or along houses, or in frames, and even among vines, is a most pliable plant. It is interesting to see how in Styria the houses of the inhabitants are covered with such vines, bearing enormous harvests. The grape is small like the small Burgundy, has few branches and is more round and dense. The berries are round and small, black, and covered with bloom. The skin is thick, so that the grape does not rot easily, in this respect resembling the Verdot of the Bordelais, and it may therefore be allowed to hang late on the tree without detriment to its colour. In this respect it is the reverse of the Burgundy. Its taste is less sweet than that of the Burgundy, but more astringent and refreshing. The wine obtained from it is in general not very dark, unless the grapes have been collected late. It ripens about eight or ten days later than the Burgundy, which is also grown in considerable numbers by its side. What this grape wants in sugar could be easily supplied by cautious addition before fermentation, and we have no doubt that if it became an object of attention to scientific cultivators, a great future would be opened to its wines.

MODE OF PLANTING AND CULTIVATING THE VINE.

The grubbing of the soil before planting is effected by the digging of large square holes. The bottoms of these are filled with bunches of green branches of trees. Upon that, earth is placed, next cow-dung, then again earth. The vines are then put into position, and covered with earth produced by the rotting of turf. They are now allowed to grow, and as they do so the portion of the ditch which was left unfilled is filled up. Every twelve or fifteen years the vines are renewed in the same manner as in Burgundy, by the sinking of the old plant. Owing to this practice, the vines do not stand in regular rows, but they are irregular as those of Burgundy and the Champagne. They are small vines, from a foot to three feet high, provided with spurs which grow the canes, and fixed to stakes. There is a curious method of manuring in use here. As the roads leading to the vineyards are at the bad time of the year almost impassable, the neighbours agree to throw all the vine branches, after cutting-time, into the road to make it passable. Every proprietor abutting upon the road takes in autumn one-half the bruised and comminuted fragments of these vine canes, and puts them into his vineyard as manure. To avoid disputes the two abutting proprietors sometimes agree to take the material alternately every other year.

VINIFICATION IN STYRIA.

The pale red wine is made from the blue Wildbacher and the blue Ortlieber. The grapes of these varieties are harvested very late, mostly after all the leaves have already fallen from the vines. They are pressed, and as they are overripe a small quantity of colouring matter remains dissolved in the juice. Here and there the berries are separated from the stalks before pressing. The fermentation for red wines is carried on in open vats, mostly in large casks from which the top has been removed. The vessels are filled with the mash and covered with a woollen cloth. The murk which rises to the top is submerged every four or six hours day and night, until fermentation is over. If the murk forms into lumps, it is broken with the hands. Fermentation lasts from seven to twelve days; and when the husks sink, the wine is drawn off, and the mash put upon the press. The pressed wine is mostly mixed with the clear drawn wine and put into barrels. Racking is effected in spring. Through the great exertions of Trummer, closed fermentation vats have now been introduced in Styria, and the consequence is that a much better wine is made than formerly.

THE PRESSING IN STYRIA.

In the German part of Styria the pressing is effected somewhat similarly to the Dalmatian method. The grapes are mashed and put upon the presses in a pyramidal heap. This heap is now, as it were, bandaged with a long flat bandage made of the root of the common juniper, and having a length of from 100 to 130 feet. The pressure is now applied, and the spiral lines of the bandage are pressed the one into the other until the whole of the juice is squeezed out. When the first pressure is over, the murk is loosened, trodden again with the feet and pressed a second time. But the Dalmatians are very greedy, and having pressed twice, and being unable to produce any more effect upon the murk by means of their feet, they now take large hammers of wood, or stampers, and stamp the unfortunate murk into a pulp, and then put it into the press again. The fluid which runs now is the mere juice of the stalks, the essence of astringency, but it is put with the wine. In the country inhabited by the Wends, however, the heap of murk is surrounded with hoops of which the lowest is the largest, and the uppermost one the smallest; and when the pressure is applied, these hoops sink one into the other until they are pressed down in a concentric layer into the pulp. The presses used in Styria are all long beam-presses. Very few screw-presses are to be seen. The beams have mostly a length of from 15 to 30 feet. The pressing beds are 10 to 12 feet square. On the small properties the greatest variety of the most original and simple presses can be perceived, such as a wooden box, the pressure on the contents of which is exercised by means of an old tree, to the end of which a stone is slung, being an exact imitation of the northern cheese-press.

QUANTITY AND NATURE OF THE WINE PRODUCED.

In Styria there are about 54,720 joch of vineyards, which produce on an average 25 eimer per joch, making a total, therefore, of 1,367,500 eimer. The northern limit of viticulture is at Gratwein in the circle of Gratz. A most beneficent influence upon viticulture and vinification was exercised by the late Archduke John, and by Professor Dr. Hlubeck. The Archduke John caused, from 1832, about 26 joch of suitable land to be planted with select varieties of vines, and introduced rational treatment of the soil and of the wine in the cellar. In consequence of this example many proprietors removed their old bad vines; planted Riessling, red Traminer, and a variety of other grapes, some of which we have already mentioned; and introduced a better management. The consequence has been that, while formerly the wines produced were not lasting, now the Styrian wines are of good taste and can be kept, although they are yet somewhat too acid, and therefore require too much time for ripening. In the Exhibition of 1857 there were ninety-nine wines; and although they had been exposed to great heat in the building in which they were exhibited, only very few had suffered through that circumstance, showing that they were intrinsically of good quality. The improvement in the vines has also produced the manufacture of effervescent wines, and the brothers Kleinoschegg received a medal for their manufacture.

Among the red wines there is prominent Vinarier. This wine has not enough colour to become an object of trade, and is wanting in body, and tastes thin and sweetish. It is made from the blue Kauka. Of the white wines those of the Luttenberg, Kirschbach, and Pickern are distinguished, and particularly valued in Styria. All these wines are made from the Moslavina, which we have described as a prominent vine of Croatia. The plant yields much acid, and at the same time a large amount of sugar, so that in good years and positions wines are produced which have body and strength, require four to five years to work off their sugar, and then are sour and astringent and require five years more to obtain bouquet. A large quantity of this wine was formerly sold as young effervescent must, but now the production seems to exceed the sale, and the Styrians are very desirous of exporting their wine to other countries. If they would sell to us, they must make their wine according to the principles we have laid down in the general part, reduce their acidity to a standard, and make them clean, dry, and faultless. From the natural capabilities of Styria we cannot doubt that this is very feasible.

WINES OF CROATIA.

Introduction.—Climate, soil, labour.—Prevailing vines.—Mode of cultivation.—Vintage, cellars, wine.—Exhibition of wines at Agram in 1864.

INTRODUCTION.

The climatic situation of Croatia is particularly favourable to viticulture. A high mountain forms its northern limit, from which many higher or lower ranges of hills run towards the south into the plain. The soil is very various, and is not everywhere very suitable for viticulture. Croatia has but one great difficulty to contend with, and that is the want of labour, in consequence of which the producers cultivate the vine for quantity, neglecting all attempts at quality.

PREVAILING VINES.

The vines which are cultivated with preference are the large berried varieties, which give vintages even when they are left in a half-wild condition, and which can be trained high so as not to be overwhelmed by the weeds. Notwithstanding that many of them have been determined by scientific oinologists, there is, in relation to general nomenclature, yet great confusion. Trummer of Gratz has given us the best information on the varieties of vines grown in Croatia. Thus, he has shown that the Moslavina, in Germany called Moslerrebe, and which has by some been supposed to come from the Moselle, is at home in the Croatian district called the Moslavina; but it is by no means an otherwise unknown vine, occurring also largely in Hungary, under the name furmint, and being the prevailing grape of the Tokay district. Further, there are the blue cinnamon grape and the red Portuguese, both well known in Styria, and supposed to come from Sclavonia. But the prevailing sorts of grapes in Croatia are the Grünhainer and Heunisch, which cannot possibly give fine wine.

Among the newly introduced sorts there is the Welsch-riessling. This particular sort is called aligottet or meslier in the department of the Marne. It takes its name from the circumstance that it was a hundred years ago transplanted to Heidelberg; thence it spread into the viticultural districts of the south of Germany, and thence through Austria into Croatia. This vine gives a sweet grape, and wine containing much alcohol, but no aroma. It is very frugal, and succeeds on soil where the ordinary Riessling and other grapes do not succeed any more. It has, however, one particular fault; namely, that of a very long fruit-stalk, which, when it is moved about by the wind, becomes easily twisted, whereupon the grapes cease to ripen, and remain acid. Its cultivation is, therefore, particularly to be deprecated in Croatia, where not a low training, which by keeping the grapes near to the ground would prevent a twisting, but a high education is usual, exposing the grapes as much as possible to the influence of the wind. The Riessling and Traminer are rarely met with.

MODE OF CULTIVATION.

The cultivation here is altogether peculiar. The young vines are produced by laying the canes of old vines, and the rooted plants are transferred to vineyards. They are allowed to grow for five or six years, being, of course, trimmed from time to time. They are then all sunk into the ground so as to produce what is termed a very extensive foot, and allowed to project from the ground to the height of from three to six feet. Thus the vine arrives at its full-bearing power in the eighth year. It is cut upon either a spur of three eyes or a cane of six or eight eyes, or even twelve eyes. The vines stand close together, and the bent cane of one is tied to the stake of the next vine. These stakes project from two to three feet above the height of the vines, which gives a height for the stakes of from nine to ten feet above the ground. The soil is worked once in the spring. Then the vine is allowed to grow as best it may until the time of the vintage approaches. At that time no human being can penetrate the vineyard. The vintagers, therefore, upon entering the vineyard, cut their way, and tie up what branches remain uncut, and in general make the vines accessible to the reapers. Behind these vine-dressers there go relays of women, who with sickles cut off the thick layer of weeds and grass. A Croatian vineyard, therefore, is a very picturesque scene, and exhibits the power of nature and the luxuriance of the vine in a wonderful degree; but its produce is of a low quality. The only excuse which the viticulturists can give for this great neglect, is that at some times of the year labour really cannot be obtained. The grapes are mostly ripe in September, so that there would be time and sun enough to ripen them to perfection; but as the viticulturists only think of getting the greatest quantity, they vintage when the grapes show the greatest volume. At this time they are still partially sour, contain much water, and necessarily give an imperfect wine. The presses are mostly the old-fashioned and imperfect lever presses—long beams, at the end of which a stone is screwed up. There is no proper basket in use in which the mash is put, but it is laid on the flat boards of the press, mixed with old canes from last year's cuttings of the vines, covered with boards, and pressed. The must which is obtained from the collected grapes is warm, and runs into a violent fermentation at once, and this is aided by the warmth of the cellars. The consequence is, that when the wine gets into the cask, most of it has already become infested by acetous fermentation. The treatment in the cellar is most deficient. What is called the cellar is nothing but a hole dug or cut out of the vineyard, over which a scanty thatch is fixed. In some few districts there are vaulted cellars, but they have many faults, and are not sufficiently large. Even the cellars of the large proprietors, which are below the press-houses and the inhabited houses, are insufficient. They are sunk only a few feet below the earth, and never contain that cool moist air which ought to be present in good cellars. The people have the idea that in order to preserve their barrels it is necessary to constantly allow the air to enter and go out. All the apertures of the cellar are therefore opened in summer, and consequently the air in the cellars is dry and warm, and causes an evaporation from the casks which necessitates frequently repeated filling up of ullage.

The wine remains in general in the cask without being racked; and if it is drunk on the spot, it is drawn direct from the lees. In Croatia, therefore, we have a striking example of immense capabilities of production, and advantages of climate lost to mankind by ignorance, indolence, and perhaps insufficiency of labour through depopulation brought about by disadvantageous territorial laws and social institutions.

EXHIBITION OF WINES AT AGRAM IN 1864.

The description which we have given of Croatia's viticulture was strikingly confirmed by the exhibition of wines which took place at Agram in the year 1864. There were exhibited above a thousand sorts, all in well-filled bottles, beautifully corked and labelled, so that the visitors passing through the exhibition would have thought Croatia to be the flower of all wine-producing countries; but of every ten bottles there was hardly one without striking faults. They all had a collateral taste, which everyone who is acquainted with the mode of the production of wine and its faults, knows to be the result of bad treatment. Most of the wines contained prejudicial quantities of acetic acid, and a great many had the so-called "taste of mice" which is the consequence of too frequent exposure to the air. A committee appointed to judge of the wines were divided in opinion whether the taste of mice was not a peculiar Croatian bouquet, or whether it was not a taste of the Croatian soil which penetrated into the grape. When they were informed that these faults were owing to the bad treatment of the wines by ignorant producers, the staunchest Croatians amongst them declared such an assertion to be a degradation of the Croatian nationality. However, the exhibition will not have been in vain as regards these persons, for at least they once heard the truth about their wines, and they can hardly doubt for long what they heard to be the truth. The judges only rarely met with a bottle which could have been sold in trade as wine without a fault. Those bottles which were good contained sweet selected wines,—so-called liqueur wines. There were also some tolerably good red wines. There is in these wines sufficient acidity, but as the grapes are harvested early the acidity is unripe. The wines, owing to the fact that they are made early, are not excessively strong. In the ordinary wines sugar is never present. Tannin is present in a proper proportion. The Dalmatian wines which were at that exhibition contained tannin in great excess, and could, by their peculiar chemical composition, immediately be distinguished from the Croatian wines. Moreover, the Dalmatian wines were highly coloured, so that if mixed with their own bulk of water they were yet equal to the darkest Burgundy. This, together with the astringency and acidity, made the Dalmatian wines of such a quality that they could not be drunk by themselves, but had, like low French wines, to be mixed with water before they became drinkable. Not a single quality of wine exhibited that finest of all achievements, bouquet. Most of them were young, but those which were not, showed that ageing could not develop a bouquet. All the exhibitors were consequently advised to pay the greatest attention to the selection of their vines, and to construct, wherever possible, new cellars on the north side of the mountains and hills, or sunk sufficiently deep into the ground to be protected from the influence of the summer sun. We have no doubt that, if they would make wines according to the rules of the art, buyers from all the world would flock into Croatia to purchase their produce, while at present they are obliged to drink it themselves or to let it spoil in their cellars. The imperfection of vinification in Croatia was further exemplified by the presses, the barrels, and the many tools which are used in the process. Of the many grape-presses shown at the Agram exhibition, only a few showed the result of the progress made in other viticultural countries. Most of them were beam-presses, and had no proper basket, and those which pretended to an advance were complicated with wheels and old-fashioned gear.

WINES OF DALMAITA.

Topography and climate. — A traveller's route. — Vineyards. — Cultivation. — Varieties of vines.—Maraschino wine different from liqueur.—Vintage and vinification.—Wines.—Sale, value, and export of wines.

TOPOGRAPHY AND CLIMATE.

Dalmatia is the most southern part of Austria. Its valleys rise from the level of the Adriatic Sea. Its north-eastern limits are formed by mountains which prevent the cold north-east wind from flowing freely over the land. The sometimes rough winds of the sea moderate the otherwise high temperature, at the same time bringing moisture which is of great importance for this rocky land. On the whole, then, the climatic dispositions are in the highest degree favourable to the development of the vine. Where olives, figs, oleander, aloe, and the palm-tree can grow together, the vine may develop itself in a splendid fashion. The traveller visiting Dalmatia leaves Trieste on board the steamer and passes the Istrian coast and the bay of Quarnaro. While the steamer passes between islands and the mainland towards the south, the traveller perceives naked mountains without any vegetation, splendid rocks for the painter to commemorate, but no means for the subsistence of man or animal. Here and there a little shrubwood rises from crevices in the rocks; and if one were to draw a conclusion from the aspect of Dalmatia from the sea-coast, one would say that it was a stony desert. On penetrating into the land, however, it is perceived that many valleys intersect the rocks. In the bottoms of these valleys there is cultivable land used partially for the production of seed plants and partly for fodder. All the slopes of the mountains, with the exception of the barren and rocky tops and precipices, are used either as meadows or vineyards. The vineyards exist altogether by the assiduity of man. The earth is carried from the valleys up the steep inclines, and fixed by means of terraces, and as the strong sea-winds would speedily blow the earth away every small piece of vineyard is surrounded by a wall of no less than six feet high. These walls themselves are mainly the result of the blasting operations carried on to reduce the inclination of the territory. They are kettles where the best wine could be boiled by the sun, very traps to catch the heat of heaven and to radiate it out again during the night. In addition to these advantages we find that the cultivation of the vine is the most careful that could be imagined. It was, therefore, no wonder that when through the vine disease the production of wine in Italy fell to one-tenth of the ordinary quantity, Dalmatia should, in a great measure, have been able to supply the want of Italy The prices of Dalmatian wine rose to threefold what they were before, but the cultivation of the vine also increased about three- or four-fold ; and during our visit to that interesting country we saw hundreds of plots of apparently barren pasture land being transformed into vineyards by the building of walls, grubbing of the soil, and the carrying of earth ; and many hundreds of men were engaged everywhere in this development.

MODE OF CULTIVATION.

The cultivation of the vine is effected as follows. Blind canes are planted ; they grow quickly to a considerable size, and are then trained up to the shape of a low tree ; for, as no wood grows in this part of the land and can only be obtained from the sea-coast with difficulty, the vine has to support itself. Owing to the strong structure of the vine, this succeeds very well, and the vineyards look very orderly. In many parts, the low basket shape of the vine is adopted, reminding us of what is called the stake plant (*pfahlstock*) in the Rhenish countries. Only in those parts which lie near the eastern frontier and within reach of forests, stakes are found in the vineyards. Each vine is provided, at the time of cutting, with spurs of three to four eyes each. When the first shoots have been formed, the barren ones are broken out. The bearing ones are allowed to grow and hang towards the ground. Here one sees that peculiar practice which is ordinarily only used with the apple, pear, and plum trees ; that of supporting the branches by means of props, a sign of the most extraordinary fertility. The vineyards are worked two or three times during the summer, and manured every five years. The manure is mostly very slight, being the produce of sheep and mules.

VARIETIES OF VINES.

The varieties of vines are so great that it has been impossible for us to determine even any considerable part of their number. On the whole, the vines usual in Italy prevail, and the Croatian varieties are only exceptionally met with, a circumstance easily explained by the fact that communication with all the other parts of the Adriatic and the Mediterranean is easier for the Dalmatians than communication with Croatia or the inland. Among the blue varieties of vines we have the Hungarian Kadarka, which is rather frequently met with. Then there are the Crelenjak, the large and small Plavec, and the Modrulj. On the islands of Brazza, Glavusa, and Nicousa, are the vines called the Vugava and Uvapasche. The Dalmatians are particularly pleased with the Crelenjak and the small Plavec. The small Plavec also occurs in Styria. It gives a slight wine, but has the property of the Albuelis of the Moselle, namely, that when it escapes the difficulties of blossom time it bears largely, but gives a slight and bouquetless wine. Among the white varieties is noteworthy a grape called the Maraschino, which is small, long, and very sweet. It is cultivated particularly on the island of Brazza, where large quantities of the well-known sweet wine, Maraschino, are made. We must here remark, in parenthesis, that the Maraschino commonly drunk in Europe is not a wine but a liqueur, and that what is ordinarily called the Maraschino di Zara is a liqueur made from spirit distilled from the fermented mash of a small cherry. In fact, the Maraschino di Zara is a cherry brandy strongly syruped. It generally has the unmistakeable taste of its origin, owing to a certain quantity of fousel oil. This ingredient causes it to be undrinkable while fresh, and involves the necessity of its being kept long. It is difficult to decide which was the original—Maraschino wine or the liqueur.

We incline, however, to the belief that the wine was the earliest. The Maraschino vine has been tried at Sebenico, Trau, and Spalato, but the plantations were destroyed by the oidium. At Sebenico and Zara we observed the yellow Orleans vine in many vineyards, of which we have given a description while treating of Rüdesheim and Feuerberg near Bingen. The general want among Dalmatian grapes is a variety which shall be capable of giving flavour to the wine. Of the muscatels, the Damascene variety is here and there met with.

VINTAGE AND VINIFICATION.

The Dalmatians distinguish two kinds of wine. The one they call "sour" (dry) and the other "sweet." To produce sour wine they cut the grapes at the time they have reached the greatest volume, transform them into mash in the vineyards, and fill them into bags made of the skin of he-goats, with the hair turned inside. Two such bags are hung on the sides of a mule, and carried home. All the Dalmatian wines, therefore, have the flavour of the he-goat; or, if this flavour from long use of the bag should have disappeared, which it very rarely does, then another flavour is imparted by the impurity which necessarily remains in a vessel which can be only imperfectly cleansed. Near Zara and Sebenico, however, we perceived that the grapes were carried home, as in the Champagne, in baskets, on the backs of mules and donkeys. When the grapes have arrived at the habitations, they are put into large vats made of deal. No oak vessels are met with in this country. The mash is allowed to stand in these vats without a cover, and without any care in the warm weather, for days, and sometimes weeks, after the fermentation is over. The hat, which rises of course, becomes sour and frequently putrid; and although this spoilt part is frequently taken off as in the Gironde, nevertheless the deal, together with the acidification, imparts to the wine a second and third adventitious flavour, namely, that of turpentine and that of vinegar. The more intelligent viticulturists who have ambition and desire to produce better wines, keep the chapeau underneath the fluid by means of netting or straw mats. The wine is then drawn and put into barrels, and the murk which remains is trodden with the feet, in order to get it as dry as it can be made. Presses are rarely met with. Where they exist, they have a very primitive shape and construction. A large stone is fixed in the yard, round which there is a square or circular channel cut with the chisel. On both sides of this stone there are holes into which two wood posts can be fixed. They are united by a cross-beam, so as to represent a gallows, and through the top of the cross-beam passes a screw made of wood. The mash is now put upon the stone, and either held together by netting, or, as in Croatia, wound round with a rope, or a kind of girdle made of straw. It is then covered with a few boards and pressed. The new wine is put into the pine-wood barrels, all of which are new, and therefore communicate their peculiar taste to the pressed wine. These barrels are brought to Dalmatia by sea, and mostly come from Trieste, whither they have been transported from the military frontier of Austria.

DESCRIPTION OF THE WINES.

It is, therefore, not a subject for astonishment that the wines should be, at the utmost, but of medium quality—mostly bad. Rarely have we drunk a dry wine which did not exhibit a flavour of vinegar, the so-called taste of mice, the taste of the he-goat, and the taste of turpentine; and all these faults are so common, that the people thereabout think them to be natural properties of all wine. They are greatly astonished when you tell them that they are nothing but the results of bad treatment. Even intelligent persons to whom we spoke did not think it worth their while to make improvements, because they could now sell the bottle of wine for twopence; and if they made it pure, they said, they would not get twopence farthing for it. The red wines are immensely dark. Like Croatian wine, the Dalmatian, when mixed with its own bulk of water, gives a fluid which is yet darker than the darkest Burgundy or Vöslau. Such wine is so astringent, that it cannot be drunk without having been mixed with water; for, if one endeavours to swallow it, it so contracts the gullet as to regurgitate and threaten to enter the windpipe. This astringency could easily be avoided if the berries were, before fermentation, separated from the stalks, and if a portion of the husks were removed from the murk before fermentation. The stalks of the varieties of grapes we have mentioned are so juicy, that one can easily press the juice from them with the fingers. The alcoholicity of the natural wines of Dalmatia varies between 7 and 10 per cent. No sugar remains in the natural wines; and we are quite convinced that if Dalmatia were to make its wines upon a rational and scientific principle, the products would be of such a quality as absolutely to command any market in the world, to the extent of the quantity produced. The white sweet wines are thick like syrup, without any aroma or other attraction. Maraschino is a sweet syrup, flowing like oil, and, at the same time, tasting a little of wine. The sweet red wines, however, are, in all respects, equal to the sweet Roussillon. The Dalmatian wines are mostly sold, and transported by ships to Italy. Fifty-four litres are worth 5*s.*, which is less than a shilling for the ten litres, or 1⅛*d.* the litre. During the time of the oidium the price rose to 26*s.*, and afterwards sank to 12*s.* From this it will be seen at what a cheap rate an excellent wine might be produced by rational means in that southern country. Much of the wine is drunk in the country itself, but large quantities are transported by land towards the Turkish frontier, and thence go into Thessaly and Epirus, and great distances eastward, to be drunk by the Greeks and Turks. At present viticulture in Dalmatia is confined to the neighbourhood of the sea, owing to the facility of exporting the wines; but the whole of Dalmatia could produce wine if it were demanded. There is, therefore, nothing chimerical in the efforts which the Austrian government are making to raise the spirit of enterprise in that country, and to direct it particularly towards viticulture.

WINES OF ISTRIA.

Topography.—Viticulture at Trieste, Italian.—Garland, bower, and chamber cultivation.—Varieties of vines.—Vinification.—Viticulture important to shipping.—Piccolo or Hansel.

TOPOGRAPHY AND VITICULTURE.

There is a viticultural district between Trieste and Pirano, and another near Rovigno and Pola. The islands of Vaglia, Cherso, and Lussin also produce wine, but by the same careless processes as are used in Dalmatia, and consequently their products are of little value to commerce. Viticulture at Trieste is practised as in Italy. A certain small portion of the arable land in narrow slips is planted with vines; but whereas in Italy the vines are grown on trees planted for the purpose, at Trieste they are trained up stakes, of which three are fixed into the ground, crossed in the middle, and tied together. Such stakes alone are capable of supporting the vines in a district where strong winds frequently prevail. At the point where the stakes cross the so-called "heads" of the vine are formed. From these heads grow the new shoots, partly up the stakes, partly hanging down on the ground and bearing their fruit. In spring, all these branches are collected together, twisted like a rope, and tied to a similar rope formed from the canes of the next vine. As the rope formed from the canes of the previous year has been cut off at the head, the head now shows short spurs. While the canes bear most of the fruit, the spurs shoot the new canes necessary for the formation of next year's rope. This may be called "cultivation by garlands." It presupposes great fertility of the soil and great warmth of climate. Higher up the hill there is a mode of training the vine, called "bower training."

There is also found in the direction towards Görtz the method of training which we found to prevail in the Palatinate, namely, the Kammerbau, with this difference however, that at Trieste the chambers are built sufficiently high for a man to walk under them, while in the Palatinate the men must either jump over the frames, or creep underneath them on all-fours. Near Rovigno and Pola, as also on the Karst, the Italian method of garlands is used. It is probable that viticulture may experience a great extension on this so-called Karst, although this strip of rocky territory is from five hundred to a thousand feet higher than Trieste itself.

VINES, VINIFICATION, AND WINES.

The varieties of vines cultivated near Trieste are all Italian. The blue Refosco and the white Malvoisie are the most esteemed, and occur most frequently, but there are from twenty to thirty other varieties mostly mixed with them. Vinification is here carried on as carelessly as in Italy. The wine of Istria, which is obtained at Trieste, shows the same faults as those which we have described regarding Dalmatia and Croatia. The public drink it as a matter of course, but the lowest wine retailer of France or Germany would not sell such drink as is sold in the first hotels of Trieste, under the name of Istrian wine, and particularly Refosco. If the visitor at Trieste wants to drink a good glass of wine, he is obliged to ask for Vöslauer, Gumpoldskirchener, or Grinzinger. The want of knowledge and care on the part of the population necessitates the importation from great distances of that which, with a little attention, they might obtain themselves much better. Nothing could be of such importance to the Adriatic as the raising of viticulture in all its provinces; for the ordinary want of shipping which goes to Trieste and discharges its cargoes there, is a back freight. If wines could be produced fit for exportation, they might be brought to almost any port of Europe, at a charge hardly exceeding the cost of ballast. Yet, how is wine made in Istria? The grapes are cut when they show the largest size; they are then put into the vats without being mashed, in order, as the people say, "to become more fully ripe." They are then mashed with the feet, and put in high narrow vats. During the fermentation the wine is repeatedly drawn from the bottom of the vat and poured on the top of the hat; and this is done as often as necessary to give to the wine the desired dark colour. The wine is then put into barrels, or more frequently left in the vats, until a purchaser appears, or is drawn from the vat, bottle by bottle until finished. During this process, of course the wine becomes spoiled in every respect. The murk is rarely pressed, but only trodden with the feet as dry as possible. After this, water is mixed with the murk, in order to produce the piccolo wine (in French called *picquet*, and in German, *Hansel*). This piccolo is, in fact, vinegar and water, with a good deal of astringency.

WINES OF GÖRTZ.

Farming at wine rent.—Effervescent wine from the "ribola" grape.—Picolit, sweet wine.

The fruit of Görtz is highly esteemed in the markets of South Germany, and particularly Vienna, but the wine produced at Görtz is very mediocre. The cultivation of the vineyards, particularly in the so-called "Ecken" or corners, is a mixture of Italian and German methods. In the valley of Wipach alone there are closed vineyards, containing, however, too many fruit trees. The system of viticulture is that usual in the Mâconnais and Beaujolais. The proprietors farm out their property to so-called "colonists;" that is, to farmers with families, who pay the rent, which consists mainly of wine, and, in rare cases, of a few quarters of grain in addition. At present, many proprietors change this system, and there can be no doubt that if viticulture were to become more common and rational in this district, a large quantity of good wine might be produced. The varieties of vines all come from Italy, and among them the Refosco is preferred. White and light red wines are also produced. Everywhere are the same shortcomings as in Dalmatia, Istria, and Croatia. Vinegar and mice taste contaminate the finest product. Some wine speculators at Görtz, however, are now beginning to buy the grapes, and produce a splendid red wine, with much colour, which is, however, yet too astringent. This fault it would lose if it were kept for five or ten years, but the maturity may be obtained at a much cheaper price by simply separating the berries from the stalks and separating a portion of the husks before fermentation. There is also made here an effervescent wine from a particular grape called the Ribola. The wine is excellent, but turbid, as the art of disgorging, as practised in the Champagne and on the Rhine, has not yet penetrated to Görtz. Large proprietors also make a sweet wine called picolit, particularly from grapes which have been allowed to become somewhat dry while lying on straw during a period of six or eight weeks. This wine is racked repeatedly, and then put in long-necked white pint bottles. There it remains for many years, until it has acquired what is called the "firn" taste, and is then considered something exquisite; but the estimation of this liquor has latterly sustained a great shock by the discovery by some shrewd manufacturers, that they can produce this firn flavour, "the infallible sign of age," in a quarter of an hour. Picolit is drunk after dinner from small glasses of the size of a thimble. There are some large manufacturers of Picolit, who carry on the drying of their grapes in drying-houses built for the purpose. They sell their wine to Turkey and Russia. Viticulture at Görtz has extended its area to at least double its former size during the last fifteen years, owing to the happy circumstance that the oidium never entered the valley. A society of intelligent men have recognized the extension which might be given to viticulture, and the improvements which might be applied to vines and wines, and have formed a company for their practical execution.

WINES OF BOHEMIA.

In Bohemia there are about 3,915 Austrian joch of vineyards, of which each produces about 13 eimer of wine. This gives an annual production of 50,895 eimer, of which 19,300 are red, and 31,595 are white wine. In the neighbourhood of Prague there are annually obtained from 500 to 700 eimer. The production of wine in Bohemia is decidedly on the decrease. The best wine is that of *Melnik*, a town situated about twelve miles to the north of Prague. This wine is made from the black Burgundy grape, the original plants of which were, according to reliable information, obtained directly from Burgundy several hundred years ago. Although the plants have never been regenerated by new importations, they have preserved absolutely their original character. The soil is chalky, resting upon sand-stone. The low parts near the Elbe contain sand and clay. The cultivation of the vine is not very intelligent. The method of rejuvenescing which is usual in Burgundy is also practised here. When the grapes are collected, they are put into vats—mostly barrels from which the top has been removed—and allowed to ferment. During fermentation stalks and husks are frequently submerged by means of rakes and other instruments, and of course, as usual, by such treatment the wine is ruined.

CHAPTER XIX.

THE WINES OF HUNGARY.

Introductory remarks.—Topography.—Varieties of soil.—Varieties of vines.—Mode of cultivation.—Vintage.—Vinification.—Classification of Hungarian wines.

INTRODUCTORY REMARKS.

THE climatic conditions of this country, and the chemical and mechanical qualities of its soil, are very favourable to viticulture. Accordingly, a great variety as well as a large quantity of wine is produced. In a report given by Stefan Morocz, on the occasion of the International Agricultural Exhibition at Hamburg in 1863, the total annual production of wine in Hungary was estimated to be 25 millions of "eimer;" or, taking the "eimer" at 54 litres (it being actually 54·1527 litres), 13½ millions of hectolitres. Of this quantity a little less than one-eighth, namely, three millions of eimer, equal to 1·62 millions of hectolitres, was supposed to be capable of being so prepared as to become fit for European or universal trade. But of this latter amount a very small proportion is as yet actually so prepared; and in the year 1859 the exportation from Pesth, the principal market for Hungarian wines, did not yet amount to 100,000 eimer. Viticulture is very imperfect in most parts of Hungary; but the treatment of wine in the cellar is frequently still worse. The landed proprietors particularly are only very partially acquainted with the theory of vinification, and mostly spoil their products. But amongst the wine merchants the treatment of the wine is well understood, and skilfully used to eradicate or subdue the faults so frequently imparted in the course of rural operations.

TOPOGRAPHY.

Hungary may conveniently be divided into five viticultural districts.

The Northern district on the left bank of the Danube is the continuation in an easterly direction of the viticultural districts of Lower Austria and Moravia. It includes the valley of the Waag, in which vines are cultivated from Trentschin to Szered; further, the valley of the Gran; but is mainly characterised by the Hegyalja mountain, containing the celebrated vineyards of *Tokay* and *Erlau,* and the less distinguished but fertile vineyards of the Bodrog, which flows from the Carpathian mountains, and the Samos, which issues from Transylvania.

The Eastern district is confined between the Theiss on the west, and the river Samos and Transylvania on the east; its southern frontier is the Banat. Its wines are represented by the products of *Erdöd, Bakator,* and *Menes.*

The Central district is situated between the Danube on the west, and the Theiss on the east; its northern limit is at Pesth, and in the south it ends at the Woiwodina.

The Western district is divided in two parts: one to the west of the Raab river, which is a continuation of the viticultural district of Lower Austria, and is represented by the vineyards of *Rust;* the other parts to the east of the Raab, and further enclosed by the Danube and Drave, including in its centre the district of the Plattensee. This part is characterized by the wines of *Ofen, Somlau,* and *Weissenburg.*

The Southern district includes the *Banat* and *Woiwodina;* the former contains the *Werschitz* mountain, and includes the *Weisskirchen* Banat.

In the following we have repeatedly indicated these districts by their capital initials only, in order to aid the reader in finding on the map the names of localities where wines are grown.

VARIETIES OF SOIL.

The Hungarian vines are grown upon a great variety of soils: some in mountainous districts, some in open plains. In these latter the soil is alluvial, frequently marshy. It is said that in these districts the wine gets a marshy taste.

The Hegyalja is a promontory of the Carpathians, sloping towards the south, and consisting mainly of porphyry and basalt. The best wines of Fünfkirchen grow on chalky hills, termed the Deindol. The Ofner wine, termed Adlersberger, grows on volcanic soil, which is a part of the series of hills running along the Danube from Pács-Megyer to Alt-Tétény. The wine of the mountain of Somlyo, or Somlau, in Veszprim county, near the Plattensee, grows on basaltic soil. The wines which grow on the lake of Neusiedl, and those which grow on the Plattensee, generically termed "lake wines" (*Seeweine*), are grown on basaltic soil, which slopes from the Badacsonyer mountains southward towards this lake. All the lake wine of Gyorköer grows on soil which is made up of one-third of chalk, and two-thirds of clay. The wine of Packsdorf, in the county of Eisenburg, is obtained on strongly ferruginous soil, while the wine of Musai, in Beregh county, comes from a soil which is partly the product of alumstone.

VARIETIES OF VINES.

Several of the varieties of vines grown in Lower Austria and Croatia are also grown in Hungary, such as the *green Velteline* and the *Silverwhite.* But there are two dominant vines peculiar to Hungary—the *Furmint,* or Tokay with white grapes, and the *Kadarka* with black grapes. In the county of Baranye there are some extensive plantations of *Burgundy pineau,* and round Villary there is much of the Rhenish Riessling, the early Portuguese, and the Oporto vine. At Ofen a black vine, *Sar feher,* occurs intermixed with the Kadarka. Then there is the "*small black,*" which ripens very late, and the "*large black,*" which is similar to, but perhaps not identical with, the "black Hambro," grown in English conservatories. A "*black Muscatel*" and a "*white Muscatel*" are also grown here on account of the beautiful large grapes and great bearing power. They ripen early, but do not give a first-class wine. They are somewhat degenerate Muscatels, inasmuch as they possess no Muscatel flavour. The white Muscatel is termed Bela in Syrmia. The "blue Augster" is also a beautiful grape, with elongated berries of a reddish blue, hardly ever of a black colour.

The Furmint (in Hungarian "*Io Formint*"), syn. white Tokay, Lake-vine, Moseler, Moslavina, is a strong vine: the one-year's rods are straight, with long internodes, of greyish brown colour, and covered with white loose wool; the green shoots are also woolly at the ends. The leaves are large and leathery, undulated, and not deeply incised, dark green above, grey-green with a thick felt below. Their stalks are rather short, being three-fourths of the length of the axis of the leaves. The bunch of grapes is large, loose, pendulous, cylindrical, sometimes divided in several lobes. The fruitstalk is short and thin, and its node does not carry a collateral bunch. The sub-stalks or berry-stalks are all long, and the basal enlargement has a brown margin, and fine light green warts. The berries are medium-sized, round, or when pressed together, elongated, yellowish green, provided with vessels, transparent, and with points on the surface. The latter is covered with a strong white bloom. The juice of the berries is sweet, and has a peculiar strong flavour. The grapes ripen early, and the earliest among them show the peculiarity that they burst and discharge a portion of their juice; after this they dry up and form a shapeless lump full of sugar, called "dry berries." These must therefore be well distinguished from the raisins of southern climates. Here the whole bunch passes simultaneously and equally into the passulated state, and the berries do not burst. But the Hungarian "Trockenbeeren" very rarely comprise the entire bunch, and are mostly interspersed with fully ripe and plump, not at all passulated berries. At the vintage these "dry berries" are separated from the others immediately after the bunch is cut off; each vintager has a small wooden vessel suspended at his waist, in which he places the dry berries picked from the bunch;

while the rest of the bunch with the plump and juicy berries is put into a large vessel standing on the ground.

Nearly all the red wines of Hungary are made from a peculiar black-graped vine, the blue Kadarka. The berries of this variety are somewhat oval, and of medium size. They are black in colour, and covered with the usual bloom. The bunches are of medium size. The leaf is very dark green, mostly three-lobed, shiny above, and a little hirsute on its lower face. The two extreme lobes of the leaf generally turn a little upward. By this peculiar twist the Kadarka can be distinguished from other varieties of vines, even at a distance. The wood is greyish brown, and the eyes and nodes approach each other to within an inch. It is, therefore, necessary to cut this vine very short. One or two eyes are left to a spur, and yet the plant in autumn will be found full of black grapes. In this respect it fatally resembles the varieties of vines in France, which, like the Gamay, yield fruit on every shoot, and give much bad wine. To get fully ripe, it requires the strong heat of the Hungarian summer; it is the only black-graped vine which yields "dry berries," like the Furmint, and thus enables the viticulturists to produce the sweet wine called "Ausbruch." Its blind canes take quickly after planting and begin to bear in the third year. The plant is very little liable to be injured by cold, in winter, spring and blossom time, and ripens its grapes in the beginning of September.

MODE OF CULTIVATION.

The cultivation in most parts of Hungary is the same as that which prevails in the Jura and Switzerland, and in many vineyards of the Upper Maine; namely, a small head or knob cultivation. The vine is planted in the ground, and four or five inches above the ground the so-called head is formed by cutting away all branches at that part as often as is necessary to develop this malformation. We have seen such heads, of twice the size of a fist, covered by the moss of many decenniums. In the district of which we are speaking, however, not many vines are of old standing, and it is to be hoped that those rational cultivators of Ofen and Erlau, who now are so busy in pushing their trade in England, will abandon this mode of cultivating the vine which wastes so many years in the production of this fancy article called the head. In spring, when the vine has driven its first shoots, which are generally eight or ten in number, the viticulturists effect what they call a "wedding." This consists in removing from the head all shoots above the number of five. At the same time they take all leaves up to the first blossom from the shoots which they allow to stand. This gives to a vineyard so treated a curious naked appearance. The viticulturists state, however, that this practice is advantageous to the blossoming, and prevents the thriving of the so-called hay-worm, a parasite which frequently becomes hurtful. To each vine a stake is fixed. The vines do not ordinarily stand in straight lines, inasmuch as they have to be sunk repeatedly in order to replace vines which have perished.

VINTAGE.

At Ofen the white grapes are vintaged first, and afterwards the collection of the black grapes begins. There is never any selection made, and all grapes are cut off at the same time. They are put in low vats and crushed by means of stampers, or trodden by the feet of men. They then go into the fermentation vats. The separation of the berries from the stalks is not usual. The vats are called *gatzen*, and have the same shape as those used in Burgundy. Fermentation is allowed to proceed until the hat or top begins to sink. The wine is then drawn, the murk is pressed, and the result of the first pressure is put together with the drawn wine; but the liquids pressed subsequently are not mixed with the wine, but kept separate for subordinate use. The proportion of murk to wine is assumed to be as follows:—One gatzen containing 150 eimer of grapes yields 120 eimer of clear wine and 30 eimer of murk. The first or drawn wine is called "sweet wine," and of this the above quantity yields 110 eimer; while the wine obtained by pressing the murk amounts to from 10 to 12 eimer. (1 eimer = 54·1527 litres.)

The presses which are usual in Hungary are the large beam-presses. The murk on the press-bed is usually kept together by means of hoops which are put pyramidally on the heap of murk, and then pressed down, the narrowest one from the top into the second, third, and fourth, until all the hoops form concentric rings lying level on the surface of the murk. There are also presses with the ordinary square boxes. The wine is preserved in large barrels, but on being sold it is generally—particularly, however, at Erlau—put into small barrels containing from 162 litres to 270 litres each.

VINIFICATION.

All varieties of wine called "*Ausbruch*" and "*Maszlacz*," including the *Tokays*, *Rust*, *Menes*, and many others, are made in this way, that a quantity of must from plump grapes is more or less fortified by means of "dry berries." This necessitates of course that a portion of the harvest is deprived entirely of its dry berries, and this now yields nothing but the *ordinary wine*. When the dry berries are not removed, and are made into wine together with the entire harvest, and without any addition of dry berries from other vintages, the so-called "*natural wine*" or "*Szamorodni*" is obtained. *Maszlacz* is made of four qualities, called one, two, three, and four "buttig," according to the quantity of dry berries added to each cask of wine. A cask of wine contains ten "butten," and the addition of dry berries to the several qualities of Maszlacz therefore amounts to either 10 or 20, 30 or 40 per cent. of the volume of the murk. Such wine is always highly alcoholic and more or less sweet. When five volumes or more of dry berries are added to the must, "*Ausbruch*" is formed. The finest quality of Ausbruch is that which runs spontaneously from the must-infused dry berries after they have been allowed to macerate a short time, and is called "*Essence*."

COMPOSITION OF THE FOUSEL OIL OF HUNGARIAN WINES.

The acid contained in this oil is chiefly caproic, with a a little caprylic, and a very minute portion of œnanthylic acid. Pelargonic acid could not be detected at all. The alcohol was chiefly amylic, with a little ethylic alcohol. Neither propylic nor butylic alcohol were found. The oil, of which 30 lbs. were examined, was obtained from a refinery of crude tartar. (F. Grimm, Ann. Chem. and Pharm., vol. clvii. p. 264.)

CLASSIFICATION OF HUNGARIAN WINES.

By this classification it is attempted to assign to the principal Hungarian wines those places which they occupy when compared with each other. It is not intended thereby to establish a comparison with either the quality or the value of any other wines which are usually classified.

A.—*Wines of the First Class.*

I. *First Order: Tokay.*—1. *Essence:* very sweet, slight amount of alcohol (7 per cent.), must be very old. When fifty years in bottle, fetches from 40*s*. to 66*s*. per small Tokay bottle. 2. *Ausbruck:* sweet, strong in alcohol; must be old. Not rarely deposits, like the Essence, sugar in crystals. 3. *Maszlacz*, of four different qualities: the quality with 40 per cent. dry berries costs at Tokay from 120 to 160 dollars per eimer, or 6*s*. the ordinary wine-bottle full. 4. *Szamorodny*, or dry natural Tokay, requires age. 5. *Ordinari.* Total production in twenty-one communes of the Tokay district of all qualities per annum: 268,000 eimer. The Mezes-Male or Imperial grows at Tarczal (market town), and does not get into trade. Next in quality are the products of Talya, Mad, Liszka, Kiszfaludy, Zsadany. Third in quality, or so-called medium Tokays, are the wines of Tokay town, Keresstur, Erdöbenye, Toloswa, Nagysarospatak (all four market towns), and of the villages Ond, Zzanto-Olassi, Ujheli, Sara, Golop, Zzegilong Zombor, Erdö-Herwathi, Ratka, Kis-Toronyia. Around these third qualities there is a large circle of twenty-five places, producing 130,000 eimer annually, which form the fourth and last quality, and include all that can have the most remote title to be called Tokay-Hegyalja.

II. *Second Order.*—Menes Magyarat, county of Arad, E. Red and white Ausbruch and natural wines, produced in fourteen localities, and amounting to 241,000 eimer annually. Vinification as in Tokay district.

III. *Third Order.*—Wines of Rust, Oedenburg county, W. 69,000 eimer produced annually in nineteen localities. White, strong, and sweet Ausbruch, and natural wine. The vintage is here mostly very late, sometimes as late as December.

B.—*Wines of the Second Class.*

I. *White Wines.*—Grow at Somlau, Veszprim county, W. Table and dessert wines.

Badacsony, on the Plattensee, county of Zala, W. Table, dessert, and Ausbruch wines.

Neszeliny, Gran county.

Ermelleker, Bihar county, C. Strong table and dessert wines.

Szeredny, Unghu county.

Neograd. Table wines.

Krasso. Dinner and dessert wines.

II. *Red Wines.*—Erlau Visonta (termed Schiller or Rubinette), Hevesh county, N.

Szegzard, Tolna county. Wines of fiery taste and a honey-like odour.

Villany, Barany county. Resembling Burgundy.

Ofner, Adlersberger. Good and strong.

Krasso.

C.—*Wines of the Third Class.*

Baranya. Good red dinner wines.

Pesth, Steinbruch, C. White dinner wine.

Hont. Good white dinner wine.

Presburg, N. Red and white.

Vagh-Ujhelyer. Good red dinner.

Weissenburg, W. Good white dinner.

Somogy. Red and white.

Bakator (Ermelleker), Bratenwein, E. White.

Eisenburg, W. Good white dinner.

Raab, W. do. do.

Balaton-Füred. White.

Erdöd, N. Red and Schiller (pale red).

Fünfkirchen, W. White strong dinner.

Miszla, Tolna county. White; acid.

Oedenburg, W. White, sweetish table wine.

Paulitsch. Strong, good red.

Neusiedl lake wine. Acidulous dinner wine.

Simonthurn, Tolud county. Strong sweetish red.

Most other wine-producing places belong to the *fourth class,* which it is unnecessary to enumerate. Their products are mostly very inferior and consumed by the population. What we have in the foregoing termed dinner or table-wine, can be bought in enormous quantities in Hungary, at prices varying from 18*s.* to 36*s.* per eimer; good ordinary wines can be bought at 10*s.* to 18*s.* per eimer.

The wines of the Banat and Woiwodina in general resemble the small wines of Hungary, and are but rarely above the third class. The cultivation and vinification are still more imperfect than in Hungary. The Werschetz mountain in the Banat yields annually about 400,000 eimer, the rest of the Temeser Banat 939,500 eimer, and Syrmia nearly 1,500,000 eimer. The free town of Werschetz is the centre of the most extensive viticultural district of Austria, producing from 200,000 to 300,000 eimer annually. Of select qualities, 150,000 eimer are constantly in store at Werschetz; of these 15,000 are first class, being sweet, alcoholic, and red. 15,000 are second class, also strong and red, but not sweet; 15,000 eimer are sweet, pale reddish Schiller wine of the first class; nearly 100,000 eimer dry, harsh, spirituous Schiller wine of the second class. Of white wines of good quality there are only about 8,000 eimer. The rest is a very low class product.

Karlowitz in Syrmia produces the "Vermouth" liqueur, and the Slibovitz or plum brandy, besides red and white Ausbruch wine. Here also peculiar vines are found; Czerna, Okrugla, Szemendria, white Bela (green Muscateller, but without flavour), and Magyocka (Magyarika, or early blue Magyar vine).

CHAPTER XX.

THE WINES OF SPAIN.

Introduction and topography.—Wines of Xeres, or sherries.—Soil.—Vines of the sherry district.—Episodical comparison of the density of sherry must with the specific gravity of must produced from different vines in various countries and years.—Density of Spanish must.—Specific gravity of German, French, and Australian musts.—Analyses showing quantities of solids and of sugar contained in musts.—Modes of making sherry.—Treatment of wines in the Bodega. — Alcoholic strength of sherries. — Natural sherries. — Simmering, boiling, and sugaring of must.—Preparation of wine for export.—Manzanilla.—Wines of Niebla, Moguer, &c.—Wines of Rota.—Wines of the Val de Peñas.—Wines of Catalonia, Aragon, and Valencia. — Valencia, Benicarlo, Alicante.—Wines of Granada, Malaga.—Viticultural statistics of the district of Xeres de la Frontera.

INTRODUCTION AND TOPOGRAPHY.

THROUGHOUT all historical times Spain has been one of the foremost viticultural countries of the world. It has not only rivalled the south of France and Italy; nay, has extinguished the wine trade which Upper Italy was once carrying on with the Mediterranean ports and England. The mountains which run along its extensive coast-lines, or accompany its rivers, offer the most favourable situations and most fertile soils for viticulture; the southern position ensures a sufficiency of sunshine to mature the grapes with more or less perfection every year; and the proximity of the Atlantic on one side, of the Mediterranean on the other, brings the moisture by the aid of which the vine luxuriates. In consequence of these natural advantages the wines grown in almost all parts of Spain have much taste and bouquet, and great strength and durability, provided they are subjected to proper treatment. In places, however, where proper vinification is unknown, the natural advantages are lost; the wines are spoiled during fermentation, become acidified, scuddy, and have to be got rid of for home consumption, or the distillation of brandy, before the summer which succeeds their production. The Spaniards produce no red wines which can compare with the fine red wines of France, the Médocs and Burgundies; they produce no natural wines with the bouquet of the Rheingau or Palatinate Riessling wines; but in the preparation of white dry fortified wines, such as sherries, and in the confection of some sweet wines, such as Malagas, they excel all other nations; and the export trade to most parts of the world which is carried on with these products, is one of the most notable sources of wealth of the inhabitants of the Peninsula. *Andalusia* produces the wines which are of most importance to English consumers. In the province of this kingdom, which has Seville for its capital, is situated Xeres de la Frontera, with the convent of Paxarete, and the belt of vineyards producing the vino secco and the abocado; there also is Rota, which produces the best red wine of Andalusia. There are Moguro, or Moguer, Negio, Rancio, and Seville itself, and other places to be described hereafter, the produce of which is second only to that of the principal places just mentioned. *Catalonia* yields annually 20,000 butts of wine, which is mostly red, and which producers seem now to have learned to preserve and ship to England as a cheap drink for the general public. The plain of Ampurdan is covered with vines, and of many other parts of this kingdom four-fifths of all cultivable land is occupied in viticulture. *Valencia* produces annually 100,000 butts of wine, from which by distillation 20,000 butts of spirits are manufactured. *Granada* with its famed Malaga produces wines and raisins; Cantaro alone can compete with Malaga by its annual production of 60,000 cwts. of raisins. In the mountains of Malaga the vine attains almost tropical luxuriance, and bears three harvests every year. *Aragon* produces dark-coloured strong-bodied wines of good taste and flavour, from the celebrated vines, the Grenache of Sabayes and the Carineña, and delivers them up to the trade of Saragossa. While the rough climate of *Navarra* does not admit of much viticulture, and the produce of Roncesvalles is insufficient to supply local demand; while *Galicia* produces a little good wine for exportation, such as that of Ribadavia and Tuy:—*Biscaya*, the most northern province of Spain, produces much wine, which is, however, unfit for exportation, owing to the protective octroi, which ensures to the producer sale and idleness, and entails upon the consumer bad quality and high price; a stigma which even the Pedro Ximenes from the neighbourhood of Vittoria is not able to remove. *New Castile*, with its classical La Mancha, produces the lightest and least coloured but most agreeable wines of Spain, such as the muscat of Juencaral near Madrid. Near to these are the wines of the Spanish Tagus, from Arganda del Rey, above Madrid, to Talavera de la Reyna,—wines of rare qualities of growth, if not of perfect preparation. *Murcia* produces thick rough wines, of which those of Cartagena sometimes come up to common sorts of Alicante. The island of *Majorca* produces a malvasie wine, which is exported by way of Palma; and *Minorca* produces a red dark wine round Alcyor, which is not exported, as on sea it spoils in bottles or casks, while the "alba flora," a light white wine of much bouquet, bears keeping and exportation.

The Spanish governments have frequently encouraged the production of wine, and have during late years given the greatest liberty to trade. The present laws impose no export duty, and open the trade to all persons alike. The tariff on imports was considerably modified in 1849, so that the English trade received better conditions for the exchange of commodities. In 1851 bottles and casks, which had previously been taxed, were admitted free of duty.

The main obstacle to the extension of the Spanish wine trade was the difficulty of transport. Thus the transport of a butt of wine from the Val de Peñas to Port St. Mary, by means of galeras or country carts, formerly cost upwards of £14, the value of the wine being only £3 or £4. With that there was the ordinary danger of tapping and mixing with water. But these difficulties are being rapidly removed, particularly by English enterprise and railways.

WINES OF XERES OR SHERRIES.

The sherry wines are, generally speaking, the products of the district of Cadiz. Cadiz is the most important maritime trading town of Spain, situated on the bay which bears its name, on the island of Leon, in the Andalusian province of Sevilla, and has 75,000 inhabitants. The district further includes Xeres de la Frontera, around which the principal vineyards are situated; San Lucar de Barrameda, upon the banks of the estuary of the Guadalquivir; Trebujena, to the north of San Lucar; and Puerto de Santa Maria, to the south of Xeres, and upon the western banks of the estuary of the Rio Guadelete, which forms the eastern frontier of the sherry district. The small localities of Chipiona Rota and Puerto Real form also part of the two principal ciudades. The new vineyards of Chiclana are, however, not within this district. The relative position of these localities can be seen on the map of Don Jorge Suter.

The vineyards of all qualities in the district of Cadiz defined as above, amount to 23,355 English acres.[1] Gorman, in his evidence before the Committee of the House of Commons, distributes the vineyards as follows :—

		Area.		Production.	
Xeres de la Frontera	... ...	10,034½	aranzadas.	31,468	botas.
Puerto de St. Maria	... ...	3,362½	,,	13,620	,,
,, ,,	... ...	1,137	,,	3,750	,,
,, ,,	... ...	1,078	,,	3,457	,,
	Totals	15,612	,,	52,295	,,

To these have to be added the 5,497 aranzadas of the *pagos de arena,* the produce of which is eaten by the populace, when the total of 21,109 aranzadas or 23,355 acres is obtained. But marketable wine is only obtained from the above 15,612 aranzadas, which, according to Gorman's statistics, produce "por un trienio 52,295 botas[2] de mosto."

[1] The surface measure for vineyards was the aranzada, of 400 square estadales, equal to 44·72 French ares. The aranzada, therefore, is a little larger than the English acre, which is equal to 40·47 ares.

[2] 1 bota = 30 cantares; 1 cantara or arroba mayor = 16·133 litres = 3·55 imperial gallons: consequently 1 bota or butt = 106·5 imp. gallons; reputed equal to 108 gallons.

If this means "in each year of an average of three years," it would be the lowest printed estimate of the production with which we are acquainted.[1] Gorman, however, stated also in his examination in chief that each acre produced on an average (per annum, we must suppose) four butts of wine, which would lead us to estimate the production as much higher than is stated in his statistical tables. Other authors[2] give higher quantities still, but without any data upon which they base their statements. Seeing what the average shipments of sherries from Cadiz are, which in 1863, for example, amounted to 66,321 butts, we are inclined to adopt Gorman's statistical tables as the most correct. Considering that wines from other parts of Spain are taken to Cadiz to be exported as sherries, and that much imported spirit of wine is added to the sherry actually produced, the increase of 14,000 to 15,000 butts in the annual exports as compared to the annual production, may perhaps be accounted for.

SOIL.

The district has four different descriptions of soil, which determine different qualities of wine. The "albariza" is the soil of the higher ground of the various sub-districts which surround Xeres de la Frontera, and is composed of the carbonates of lime and magnesia mixed with clay. This produces the finest wine. To this follows the "barros," or red iron ochre soil, which produces a very fine wine, inferior only to that grown on the "albariza." In these two soils only about three butts to the acre are obtained. The "bugeo" or alluvial soil, and the "arenas" or sands, produce inferior wines in quantities of from five to six butts to the acre. East or north-east of the Xeres district the soil appears unproductive.

[1] Mr. C. Ritchie, of the firm of P. Domecq and Co., informed us that 46,000 butts of wine was a full vintage at Xeres.

[2] *E.g.* Shaw, p. 214, states the annual produce to be 150,000 butts, which is greatly exaggerated.

VINES OF THE SHERRY DISTRICTS.

Of these we know at present little more than the names. The inquiries which we directed on this subject, as well as others, to some of the largest sherry-importing houses in London, or to producers abroad, remained without result. In the former places the information does not seem to exist; in the latter it seems to be withheld. We are in hopes of being able to fill up this void in the literature of our subject by an immediate personal investigation.

The dominating vine in Xeres seems to be the "Palomino." The same vine, but under the name of "Gazuela," preponderates at Puerto Santa Maria, and under the third synonym of "Hogazuela" at San Lucar. Next in frequency seems to be the "Perruno" and "Canocaso." Of the "Albillo" we question whether it is the Albuelis of Columella, and identical with the Pedro Ximenes, of which more below. The "Mantuo Castellano," and the "Beba," are also frequently met with. Distributed amongst the former, but not dominating to any extent, are the vines enumerated in the following:—"Perruno negro, P. morado, and P. de culo del Obispo;" "Palomino negro, and P. morado;" "Cujon de Gallo;" "Verduagilla;" "Ferral;" "Mantua Ladron, M. Cordoves, M. Jardiu;" "Abejera;" "Quebrante tinaja;" "Santo Paulo blanco, S. P. negro;" "Pedro Jimenez loco;" "Moscatel morado, M. blanco."

Of the foregoing vines only the following were found by us in the Chaptal collection of the Jardin du Luxembourg, at Paris, in autumn 1866:—Santo Paulo blanco, No. 1051; Pedro Jimenez loco, Lux. Nos. 229, 978, and 2012. If this vine is, as is alleged, identical with the Gouais blanc of the French, then Nos. 101 and 150 have to be placed under the same category. Clemente Roxas relates that this vine had been transplanted by one Pedro Simon (Ximon) from the Moselle and Rhine to Malaga, and thence to Spain. Some German authors claim it to be the Weissalbe[2] or Elbling. The Luxem-

[1] See Gorman, Statist. Tables, Commons Rep. [2] Babo, p. 234.

bourg collection contains further under No. 1054, a vine termed "Cherès," which is probably the Palomino. It must be understood that all those vines amongst the foregoing, which have colouring qualities, cannot easily be used for sherries.

EPISODICAL COMPARISON OF THE DENSITY OF SHERRY MUST, WITH THE SPECIFIC GRAVITY OF MUST PRODUCED FROM DIFFERENT VINES IN VARIOUS COUNTRIES AND YEARS.

Density of Spanish Must.—The most telling and useful comparisons will be those which concern musts of different varieties of vines grown as nearly as possible under the same conditions. But every observation of the density of a must in every locality has a local value, as prognosticating the nature of the wine, and the means of its amelioration. The following observations have, however, a peculiar value, as they enable us to arrive at a reliable judgment regarding the much-discussed point of the natural strength of Spanish wines. They were made by Simon Clemente Roxas, the monographer of the vines of Andalusia, towards the end of the last century, at the time of the vintage of each variety of grapes, and the density of the must was observed by Baumé's areometer, but without any reference to temperature.

Names of the Vines.	Names of the Vineyards.	Dates of Observation.	Degrees of the Must.
Listan, common	Hornillo	September 15	10°5
,, ,, ...	La Palmosa ...	,, 15	11°
,, ,, ...	,, ,, ...	,, 26	11°8
,, ,, ...	Miraflores ...	,, 19	11°5
Tempranillo	——	October 5	14°
Palomino	San-Lucar ...	September 19	10°5
Mantuo castillan	,, ...	,, 15	9°
,, ,, ...	,, ...	,, 19	9°75
,, violet	,, ...	,, 19	10°5
Torrontes	——	,, 27	13°
Jaën, black	San-Lucar ...	,, 19	11°5
Mollar, black	,, ...	,, 15	9°
,, ,, ...	Paxarete ...	,, 30	12°

Names of the Vines.	Names of the Vineyards.	Dates of Observation.	Degrees of the Must.
Albillo castillan	——	September 15	12°
,, de Huelba	Trebugena ...	,, 28	13°
,, loco	Paxarète ...	,, 30	12°
Llorona	Trebugena ...	,, 28	10°
Tintilla	Chipiona ...	,, 26	15°
Beba	San-Lucár ...	,, 19	9°
Cienfuentes	Paxarète ...	,, 30	13°
Heben	,, ...	October 2	15°
Perruno, common	——	September 19	12°
,, black	San-Lucar ...	,, 10	10°
,, duro	Paxarète ...	October 2	14°
Ferrar, common	San-Lucar ...	September 20	8°5
Moscatel	La Palmosa ...	,, 26	13°
Canocazo	San-Lucar ...	,, 19	11°5

By means of the tables to be given below we can easily calculate the amount of sugar contained in these musts, and hence derive the strength in alcohol of the wines which they are capable of yielding. We shall here only treat of the lowest, 9°, an intermediate, 12°, and the highest density, 15°, found. The density 9° corresponds to specific gravity 1067, and, judged by Fehling's table, would not contain more than 14·5 per cent. of sugar. These could at the utmost yield 7 per cent. b. w. of alcohol, an amount which indicates a feeble wine. The density 12° corresponds to specific gravity 1091, and, judged by Fehling's table, might contain 19·6 per cent. of fruit-sugar. This might yield 9 per cent. b. w. of alcohol in the future wine. The density 15° corresponds to specific gravity 1116, and concerning this we have no guide in Fehling's tables. It may correspond to 30·9 per cent. of solids, and perhaps to 26 per cent. of sugar, and would yield a wine with probably from 12 to 13 per cent. b. w. of alcohol.

Specific Gravity of German, French, and Australian Musts.—The best and most connected series of observations on this subject has been made by Schübler (Weinbau und Weinbereitung in Würtemberg; Stuttgardt, 1831) upon the must produced in the neighbourhood of Stuttgardt during the years 1801 to 1829.

Year.	Mean density of Must.	Highest density of Must.	Lowest density of Must.	Number of Observations.
1801	1060·5	1072	1045	15
1802	1074·8	1076	1060	18
1803	1065·0	1074	1069	18
1804	1065·7	1071	1065	23
1806	1059·0	1065	1049	22
1807	1068·5	1082	1070	22
1808	1064·8	1070	1065	25
1810	1066·9	1081	1065	19
1811	1081·3	1090	1070	27
1812	1063·0	1068	1057	19
1813	1061·0	1067	1056	15
1817	1051·2	1077	1044	10
1818	1073·2	1080	1063	12
1819	1073·2	1082	1065	18
1820	1059·4	1065	1054	15
1821	1053·5	1069	1049	23
1822	1080·0	1091	1070	33
1823	1061·0	1063	1051	23
1825	1077·1	1080	1067	23
1826	1065·0	1075	1060	10
1828	1068·4	1095	1058	13
1829	1060·8	1080	1051	7

The same author has collected data concerning the mean density of the must, in the neighbourhood of Stuttgardt, during seven periods between 1754 and 1830.

Years.	Mean density of Must.
1754 to 1760	1069·3
1761 " 1770	1065·2
1771 " 1780	1069·3
1781 " 1788	1066·1
1801 " 1810	1065·6
1811 " 1820	1066·6
1821 " 1830	1068·0

The observations of various authors on this point made in different localities have been collected by Mulder, and tabulated by Ladrey.

Locality.	Maximum density.	Minimum density.	Years.	Names of observers.
Touraine	1082	1063	—	Chaptal.
South of France	1128	1103	1822	Fontenelle.
Neighbourhood of Stuttgardt	1099	1066	—	Reuss.
" " Marbach	1054	1047	1809	Günzler.
" " "	1084	1074	1811	"
Banks of Neckar	1090	1050	—	Schübler.
Neighbourhood of Heidelberg	1091	1039	—	Metzger.

The following observations of the density of the must of two varieties of grapes in fourteen consecutive years were made on two estates of Gevrey Chambertin.

Years.	Degrees Beaumé found by Areometer.		
	First Estate.		Second Estate.
	Pinot.	Gamay.	Gamay.
1842	13°75	—	—
1843	11°75	—	—
1845	—	8°5	—
1846	13°25	12°	11°
1847	12°	10°	9°
1848	—	—	9°8
1849	13°25	12°	11°
1850	12°50	10°50	9°5
1851	11°	9°	8°
1852	12°25	10°75	8°5
1853	—	—	8°
1854	12°75	12°75	—
1855	12°75	10°	9°2
1856	11°75	9°	8°4

In these observations the must of Pinot always shows a higher density than the must of Gamay, of the same estate. The Gamay-must of the second estate is lower than the must of the same vine from the first estate.

Densities of Australian Must obtained at Dalwood, on the Estate of the "Hunter River Vineyard Association," given in a speech by Mr. Wyndham, at the Annual Meeting of the Association, and reported in the *Maitland (Australian) Mercury* of May 6, 1865.

The figures given are degrees of Balling's saccharometer, and would indicate sugar if the must were a pure sugar solution. But we know that such is not the case; that there are always certain quantities of acids, salts, albuminous and extractive bodies, and gum present, the proportion of which, in different musts of the same specific gravity, may vary within wide limits as shown on Fehling's table.

		Min.	Med.	Max.
1858.	Very fine vintage	24	25-26	27
1859.	Grapes damaged by caterpillars	22	—	27
1860.	Before the rain	22	23	25
,,	After the rain	19	—	—
1861.	Very rainy	15	16	17
,,	Later dry weather	18	—	20
1862.	Favourable season	21	—	—
,,	Black verdot	—	24	—
,,	Best white grapes	—	24	—
1863.	Before the rain	23	24	32
,,	After the rain	18	19	20
1864.	Very rainy	15–18	19–20	21
1865.	Very rainy	22	—	26

Musts at the Bukkulla Estate of the same Association.

1860.	—	—	60
1863.	38	—	40
1864.	24	—	38
1865.	38	41	45

Some of these last specimens must be either musts from raisins, or produced by the addition of sugar.

Analyses of Must, showing the Quantities of Solids corresponding to the Densities, and the Quantities of Sugar usually present.

Most of the older observations of the density of must have been made by means of Baumé's areometer for fluids heavier than water. This has twenty divisions, which correspond to the specific gravities, as is shown in the following table. The absolute weight of a hectolitre of must, and the weight of the dry residue left by or contained in a hectolitre of must, is given for each specific gravity.

Degrees of Beaumé's Areometer.	Corresponding spec. gravity.	Weight in kilos of 1 hectolitre of Must.	Weight in kilos. of dry residue or solids contained in 1 hectolitre of Must.
1	1008	100 kilos. 800 grms.	1 kilos. 128 grms.
2	1015	101 ,, 500 ,,	4 ,, 000 ,,
3	1022	102 ,, 200 ,,	5 ,, 856 ,,
4	1029	102 ,, 900 ,,	7 ,, 728 ,,
5	1036	103 ,, 600 ,,	9 ,, 600 ,,
6	1043	104 ,, 300 ,,	11 ,, 456 ,,
7	1051	105 ,, 100 ,,	13 ,, 600 ,,
8	1059	105 ,, 900 ,,	15 ,, 728 ,,
9	1067	106 ,, 700 ,,	17 ,, 856 ,,
10	1075	107 ,, 500 ,,	20 ,, 000 ,,
11	1083	108 ,, 300 ,,	22 ,, 128 ,,
12	1091	109 ,, 100 ,,	24 ,, 256 ,,
13	1099	109 ,, 900 ,,	26 ,, 400 ,,
14	1107	110 ,, 700 ,,	28 ,, 528 ,,
15	1116	111 ,, 600 ,,	30 ,, 928 ,,
16	1125	112 ,, 500 ,,	33 ,, 328 ,,
17	1134	113 ,, 400 ,,	35 ,, 728 ,,
18	1143	114 ,, 300 ,,	38 ,, 128 ,,
19	1152	115 ,, 200 ,,	40 ,, 528 ,,
20	1161	116 ,, 100 ,,	42 ,, 928 ,,

The foregoing indications are correct for fluids at the temperature of 12°5, the specific gravity of water being assumed as 1000. It is certain that the greater part of the solids of every must is made up of sugar, but its exact amount has not often been determined. There are a few instances in which this has been done. Thus M. de Vergnette found in a Burgundy must of the year 1849, 23 per cent. of dry residue, and of this 20·65 mere sugar, as ascertained by the polarometer; therefore 2·35 per cent. of the must were acids, salts, albuminous and extractive matters. It is always preferable to make the determination of sugar in must by means of the alkaline copper solution, in order to avoid the source of error arising from the simultaneous presence of dextrose and levulose sugar. This was done by Fehling, who obtained the following results by his analyses. (Handwörterbuch de Chemie, ix. 676; 1864.)

Specific gravity.	Sugar per cent.	Specific gravity.	Sugar per cent.	Specific gravity.	Sugar per cent.
1059	12·0	1077	17·2	1088	17·1
1062	12·5	1078	15·5	1088	19·6
1062	12·8	1079	14·9	1089	18·2
1064	13·4	1079	16·3	1089	23·2
1064	14·0	1079	20·2	1090	24·6
1065	13·9	1080	17·5	1090	26·7
1066	14·5	1081	17·6	1091	18·6
1068	14·2	1083	16·6	1091	19·6
1069	14·7	1083	17·1	1091	20·4
1069	15·0	1083	18·2	1092	19·2
1069	15·8	1084	18·5	1093	20·4
1070	14·4	1085	17·2	1094	19·6
1072	16·3	1085	18·4	1095	21·3
1073	16·5	1085	18·7	1095	27·0
1074	15·6	1085	20·4	1095	28·1
1074	15·9	1086	17·8	1096	21·3
1075	16·8	1086	19·8	1096	26·7
1075	17·0	1086	20·0	1097	24·7
1076	16·0	1087	17·8		

These data are quite sufficient to prove that the principal wines of Spain are not naturally stronger than the principal wines of France or Germany, that they are able to consume the whole of their saccharine matter by natural fermentation, and become natural wines; and if properly treated do not require either plastering, or the addition of brandy, spirit, or boiled must.

MODES OF MAKING SHERRY.

Many producers of grapes and proprietors of vineyards are also makers of sherry, but the occupations do not necessarily go together. Like the manufacturers of champagne, the makers of sherry buy much more must or wine from other growers than they produce themselves. Most commonly the makers or proprietors of bodegas[1] buy grapes. The grapes

[1] Bodega (apotheca) is a storehouse or repository above ground, and corresponds to the French *chais*.

are mostly dusted over with plaster of Paris. As will be seen from our special section on this subject, pp. 119—123, we have been unable to discover any rational grounds for this practice. They are then trodden by men on those large wooden platforms which, as they serve as the basis of the presses, are mostly called presses themselves. The juice which runs spontaneously during the treading is by some kept separate; others mix it with the juice which is obtained from the whole of the murk by the press. A practice, formerly more adhered to, consists in putting the whole of the trodden mass and juice into vats, and letting everything undergo fermentation together. Owing to the stalks and husks, this proceeding gave a much harsher wine than that which at all events separates the grapes from the stalks. But the best and most quickly maturing wine is no doubt obtained from the freshly pressed pure juice. The juice is filled into butts, and these are transferred from the press-house to the bodega. Here the must ferments. Soon after the first fermentation is over the liquor is racked from the gross lees, and each butt of new wine receives an addition of spirit, varying according to the strength of the wine and spirit in amount from six to ten gallons.

TREATMENT OF WINES IN THE BODEGA.

Common sorts are racked and fined and mixed with further quantities of spirit, so as to be in an exportable state eighteen months after the vintage. Better sorts have to remain in the casks for two or three years before their sale can be contemplated. The best wines, which come under the description of Vino fino, Amontillado, and Manzanilla, are used for the production or keeping up of "soleras." A solera is a thing kept by itself; a solera wine is a choice, old, "cabinet" article. But solera wine is not ordinarily used for drinking; its use consists in blending with other sorts to give them quickly the appearance of age and ripeness. A solera wine is, as Mr. Bernard describes it, a fine old mother-wine, which by care and attention has acquired body and character. Such wines are kept in stock in butts or double butts, and are perpetuated in the following manner. Of say twenty butts of existing ready solera wine, the proprietor draws off one-half for mixing with the wines about to be exported. He then fills up the voids created in his twenty butts by means of ten butts of the finest wine of a later vintage which he can obtain. In old-established houses solera wine is therefore a mixture of a great number of wines, of which the latest addition forms one-half, the last but one a quarter, the last but two an eighth of the whole bulk, and so forth in a ratio which terminates only with the first solera originally produced without any mother-wine. The production of this solera wine is a kind of chemical infection, whereby good wine is induced to undergo quickly a process of etherification. The process becomes so potent in some soleras that they are absolutely nasty and undrinkable, like most essences, but command prices of from 800*l.* to 1,000*l.* per butt, on account of the large quantity of flavourless wine which a certain small amount of them is able to infect with the desired sherry flavour. The solera wine is thus seen to correspond to the liqueur used in the manufacture of champagne.

While the production of good soleras is the principal object of the care of the superintendent or captain of the bodega, he has, on the other hand, also the newest wines and the more advanced ones under his charge. He classifies the wines and describes them by marks upon the casks. These marks are single, double, or triple palma, which have the same significance as the X., XX., and XXX., used in the qualification of beer in this country. By additional modifications of the palma, ten or twelve qualities are not rarely distinguished. Sherries have the peculiarities of all wines in a most marked degree; namely, to develop unequally if the same product is kept in different casks. A certain number of casks of a good vintage will soon develop itself into Amontillado; that is, wine of a quality resembling to the wine from the district of Montilla, while another number of casks of the same wine will remain common and undeveloped, or develop differently, or take an unfavourable turn altogether. This depends no doubt upon the physical conditions under which the respective casks are kept; but the sherry makers have not as yet found out these conditions, and assert that the production of Amontillado is entirely a matter of chance, and cannot be at all engendered or assured by any act of theirs. In consequence of this inequality in the development of sherries the captain frequently inspects and tastes the wines in the bodega, and often finds reason to modify his former marks according to the nature of the change which the wine has undergone.

Mr. Barnard states, that no spirit is added to the must during the process of manufacture, or pressing the grape in the vineyard, unless it is intended to make sweet wine. In that case six arrobas of spirit, equal to 21·3 imperial gallons of 60° per cent. over proof, are added to the butt of murk. When this wine, which now loses only a portion of its sugar by fermentation, is drawn off the lees about six months after the vintage, an arroba or more of the spirit is added, so that each butt contains from 24 to 25 gallons of spirit of 60° per cent. over proof, besides what it has been able to develop from its own sugar. This wine is not usually exported, but, like the soleras, is used for the preparation of other wines intended for the English market, to which it imparts body, strength, and more or less lusciousness.

The wines intended for white dry wines, and eventually to be made up into what is known in England as sherry, have about two gallons of spirit added to the butt, when drawn off the gross lees in the month of March or April following the vintage, and during the rearing of them further small quantities from time to time as required. The better sherries receive less additional spirit than the inferior wines.[1] The lower the quality of a wine naturally, the more alcohol has to be added to it to prepare it for shipment. The innate alcohol of such low wines is probably not more than 8 or 9 per cent., more frequently less. The inferior wines contain a larger amount of albuminous matter, which disposes them to spoil, particularly to become ropy, and therefore in the absence of more desirable preservative agents or procedures a sufficient

[1] The reverse obtains with port wines, of which the best and naturally strongest require the greatest amount of extraneous spirit (say 20 per cent.) to keep them in a sound and improving condition. (See Bernard's Report, p. 21.)

amount of brandy has to be added to stop all change. Most commonly from 6 to 10 gallons of brandy (of 60° over proof) are added to the butt of sherry.

ALCOHOLIC STRENGTH OF SHERRIES.

It is impossible to state in the present state of affairs, how much of the alcohol of any particular sherry is natural, how much added. Most sherries which were analysed contained from 33 to 40 per cent. of proof spirit. A butt of sherry of the latter strength, therefore, contains about 43·2 gallons of proof spirit, or 24·6 gallons of absolute alcohol.

In the report of Mr. C. Bernard to the Government, of December 14, 1861, published with others in a parliamentary return ordered to be printed on April 29, 1862, the history and strength of various wines is given. Five samples of "vino fino," from the San Lucar district, were drawn from casks in the bodega of the producer, M. P. Manjòn, who assured Mr. Bernard that they were perfectly natural, the spirit in them being the product of their natural fermentation:—No. 1, 1857, had 26·5° of proof spirit, which corresponds to 17° of the centigrade on Gay-Lussac's scale; No. 2, 1856, had 27·2° proof spirit, or 17·5° per cent. alcohol; No. 3, 1855, again 26·5° proof spirit; No. 4, 1849, rose to 27·9° of proof spirit, or nearly 18° per cent. of alcohol; and No. 5, 1841, had 27·2° proof spirit, or 17·5° per cent. of alcohol. The next and last samples of alleged natural sherry collected by Mr. Bernard are No. 10, vintage 1852, from Don José Romero Gi, grower, Xeres, who kept it for his private use; it contained 27·2° proof spirit. No. 12, Amontillado, year unknown, contained 29·2°, and No. 13, Amontillado, year unknown, 35·4° per cent. proof spirit; both the last samples came from Mr. Campbell, Vice-Consul Port St. Mary, proprietor. It is expressly stated that Nos. 12 and 13 were pure wines, unmixed with spirit and unfined. These two last wines we must absolutely refuse to accept as either genuine or natural, but declare to have unquestionably been mixed with spirit in the ordinary manner, and the sample 13 in particular, to the ordinary extent. Mr. Bernard adds that it is generally believed that these wines (like Nos. 1 to 5) will increase in strength by age while in cask. This increase might be effected in two ways; namely, by the fermentation of sugar present, or by the evaporation of water. The question can therefore not be decided without due regard to the quantity of sugar and other ingredients, more particularly as both causes might co-operate in producing the increase in strength. But even a wine of 26·5° of proof spirit is upon the limits of what is chemically possible, because fermentation, even under the most favourable conditions, is invariably arrested by the presence of about 15 per cent. of alcohol. It is therefore necessary either that the chemical experience should receive correction or explanation, or that the singular conditions should be elucidated, under which sherry wines reach an exceptionally high alcoholicity. This can only be done by the analysis of the must as it leaves the press, and by subsequent observations of the proportion between sugar, alcohol, acids, ethers, glycerine, and all ingredients which are products or feeders of fermentation.

NATURAL SHERRY.

Wines have been sold in England at various periods, and are even now offered, under the name of "Natural Sherry," which were alleged not to have received and not to contain any adventitious brandy or alcohol. But as we are quite certain that no natural sherry ever ranges above 12 per cent. of alcohol, and as all these so-called natural sherries contained from 13·2 to 15·5 per cent. of alcohol, they must have received an addition of at least 1½ to 3½ per cent. of alcohol. A wine called Spanish Chablis was also sold for a short time, which, although it had some commendable qualities, notably only 12 per cent. of alcohol, yet possessed no keeping qualities, and quickly became viscous or scuddy even in the cellar. Now, however, some amontillados and sherries are offered for sale, which in their alcoholicity (12 to 13·6 per cent.) closely approach the undoubtedly natural and unbrandied wines of the Rheingau and of Sauternes, though containing about 1 or 2 per cent. of alcohol more than these. Their taste is freely vinous, rich, pure, mellow, and quite free from heat, or the taste of added spirit. They are treated with particular care, and are obtained in a brilliant state by the importers by means of a new process which clarifies the wines instantaneously, without any addition of finings or any chemical agents whatsoever. If these wines prove durable,—and we believe that they will prove so,—they will no doubt become favourites of the wine-drinking public.

SIMMERING, BOILING, AND SUGARING OF MUST.

Colour and sweetness are also imparted to sherries, as to most other Southern white wines, by the addition of syrup made from must. The small proprietor boils his grape syrup in earthen vessels. But some large houses have special boiling pans, not unlike those used in sugar refineries, constructed with ingenious contrivances for applying the fuel and emptying out the syrup. A circular pan, with a long spout on one side, rests on a circular fire-place or hearth. On the left is attached a rope and pulley by which the pan is lifted on one side, to pour its contents into the vat on the right. Such a pan of 4 feet diameter can in 24 hours reduce from 3,000 to 4,000 litres of average must to the required standard. While some make syrup of a portion of the must, and mix this with the rest of the unboiled must, others who have better apparatus boil the whole of the must, until it has the desired degree of concentration. This is indicated by a specific gravity of 18° Beaumé, at 12° C. temp., or the same degree which the juice of the best Muscatel of the best situations reaches in the most favourable years. Though simmering the must is still a common practice, it is no longer concentrated on a large scale; but sugar, either starch or cane, is added to produce the desired must. The boiling of syrup, however, prevails as much as ever; it produces colour by the formation of caramel on the overheated margins of the pan; but it also not rarely imparts bitterness and that disagreeable flavour which some people, who exaggerate an otherwise just predilection for dry wines, declare to be the essential property of brown sherry. The boiling of the entire must leaves the wine paler, and of the same flavour as unboiled must.

The boiling of must has the additional advantage of removing much albuminous matter from it, which otherwise would remain dissolved and be capable of transformation into ferment. But this removal can be effected by processes adopted by the manufacturers in the south of France, *e.g.* Lunel and in the Champagne, with equal if not greater facility.

PREPARATION OF WINE FOR EXPORT.

When the proprietor of the bodega receives an order to prepare a certain number of butts of sherry, he mostly receives therewith a limitation of price, and an injunction to send exactly the same quality as that sent on a former occasion. For so small is the knowledge of the public regarding wine, that they suppose it possible to have the same wine all the year round and all their lives, and wine merchants are unable or unwilling to overcome this prejudice. The makers of sherry, therefore, always keep samples of their shipments; and on the receipt of the order, work up to this standard by mixing.

A sample is first mixed, and a proportion of each ingredient taken is noted. When the new sample is as near the standard as practicable, the great operation is performed. This is done either by vatting (as is frequently done in the London docks, on a large scale), or by mixing in detail in the butts themselves. The body is first put in, and by it the main value of the wine is determined. To this are added the various smaller quantities to impart what body, sweetness, flavour, or colour may be needed. Dryness is favoured by an addition of Amontillado and brandy; lusciousness by an addition of sweet old wine. Soleras, which are used sparingly for such bonification, are sometimes called "doctors." Mr. Bernard has given the proportions of ingredients of which a butt of sherry for England was generally made up in 1860:—

1 jar of spirit, about 60 o. p.
8 jars of sweet wine, or dulce.
7 jars of soleras, or mother-wine.
10 jars of dry wine, 1854.
14 jars of dry wine, 1859.

40 jars of sherry.

From the whole of such an operation there result a number of from 20 to 50, or 100, butts of sherry of uniform quality. The butts are branded with the particular trade-mark of the maker, numbers, and other signs by which the particular quality or shipment is signalised, and shipped off to the destined market.

From the above it is evident that a proprietor of a bodega requires to be possessed of a very large stock, if he intends to be able constantly to satisfy the curious demands of the consumers.

MIXING STATIONS.

Cadiz.—There is a place at Cadiz called the Aguada, where inferior wines are received from various parts of Spain for the purpose of mixing with sherry, to be shipped to England and other countries as sherry-wine. The wine from the Condado de Niebla is preferred to any other wine for mixing.

Bay of Rosas.—Here wines are mixed for North and South America, but not for England. It is reported that French wines from Port Vendres are brought hither to be mixed and exported as Spanish.

MANZANILLA.

The wine which bears this name is produced in the district of San Lucar de Barrameda. The vineyards are in a favourable locality. The soil is a happy union of alluvium, sand, and albariza. The species of vine has not been described, but its grape is said to be full of flavour, and to ripen early. The wine is rank and common, but improves in taste and flavour by keeping. When its fermentation is perfect, it is of light body, light colour, and has great lasting qualities; but withal it is so peculiar, that a person unaccustomed to it would believe it to be a medicinal tincture rather than a wine, and require some length of time to habituate himself to its enjoyment.

Some derive the name from the town of Manzanilla in the Condado de Niebla, near Seville. Others believe it to be derived from Manzana, an apple. Others, again, think that its taste, flavour and fragrance, and slight bitterness, remind of the camomile flower; and that, as this is termed Manzanilla, the wine was called after it. It is also alleged, but by no means proved, that some descriptions of Manzanilla wine are produced by the addition to ordinary wine of essential oil of camomiles and other ingredients.

FASHION INFLUENCING SHERRY.

During the last fifty years the fancies of sherry drinkers for various colours of sherry have repeatedly changed. The ignorant mostly believe a dark drink to be the best and strongest, and a reaction in favour of pale wine is nearly always the result of particular external influences. In 1825 the wines from San Lucar came much into vogue. They were pale, and received fanciful names, such as "rockwater sherry." But, owing to their want of body and high alcoholicity, they had gradually to be assimilated to Xeres wines. The Manzanilla period produced, or favoured, a taste for dry sherries, which a few years ago culminated with many so-called connoisseurs in the consumption of curious, bitter, strongly-flavoured drinks, with upwards of 40° of proof spirit. A certain age is a good quality in a sherry, as well as any other wine. The ethers become developed, and impart a rich flavour; but after a certain time the wine falls off in body, and becomes bitter and disagreeable, though highly flavoured. Such old wine is only good for imparting flavour to young wine.

WINES OF NIEBLA, MOGUER, ETC.

The district from Moguer towards Seville, on the right bank of the Guadalquiver, is called the Condado de Niebla. It produces white wine of an inferior description, but from the same species of vines as are cultivated in the best vineyards of Xeres. The wine is perishable, and will generally decompose before its third year is over, unless a large amount of alcohol is thrown into it. It is mostly brought to Cadiz, and there made into "sherry."

WINES OF ROTA.

These are mostly coloured wines, or Tintos, whence the English name of "Tent." They are all "simmered," as it is termed, and possess no particular qualities. They are at their best while quite young, and deteriorate with age.

WINES OF THE VAL DE PEÑAS.

The wines produced in this district are mostly red. About twenty years ago the growers had neither staves nor coopers to make casks, and the wine was still preserved in hides, as of old. Some enterprising wine merchants, however, sent casks, and brought them full per waggon to Port St. Mary, risking the usual dangers. Mr. Bernard obtained from a grower two sweet white wines (No. 22, vint. 1849, and No. 23, vint. 1851), which were drawn from large butts above ground. He was assured that they were in their natural condition ; they yielded respectively 22·0 and 31·3 per cent. of pr. sp. Mr. Bernard himself thinks the latter strength so high in comparison with the former, and so unusual in a sweet wine which has not been treated with spirit, that he supposes some error must have occurred. The red wine (No. 29, vint. 1850) was drawn from immense earthen jars, capable of holding three to four butts each, and kept in cellars. It was the ordinary wine of the district, gave 27·9 per cent. of pr. sp., and had every character of a natural wine with moderate excellence.

WINES OF CATALONIA, ARAGON, AND VALENCIA.

These districts produce some beautiful wines. The Catalan used to be shipped largely to South America, and much of it is at present imported into England, and sold as Catalan or Spanish port. Carineña in Aragon yields a light red wine of exquisite taste and flavour, of which the earliest importations by Dr. Gorman were much liked. The Valencia is perishable, and has no great reputation. The best qualities are grown on the hill-sides; the greatest quantities in the plains. The latter are mostly distilled for brandy, of which 600,000 cantares, or 2,130,000 gallons, are annually produced. Mr. Bernard obtained three samples of Valencia from Grao. The first two were red dry wines, vintage 1860; one yielding 28·6 per cent., the other 25·9 per cent. These were stated to be quite natural; but if required for exportation, five gallons of spirit per pipe would be added to preserve the wine on the voyage. The third sample was a red sweet wine, vintage 1860, which had been prepared, to be forwarded to England, by 7½ gallons of spirit per butt being added on the first drawing off the lees, six months after it had been made. The resulting strength, 28·6 per cent., showed it originally to have been but moderately strong, as might have been expected in a sweet wine. A sample of the spirit used for fortifying these wines gave a strength of 62·2 per cent. over proof. The quantity of red dry wine made in this province considerably exceeds that of the sweet sorts. Stocks are not kept longer here than twelve months.

In the district of Benicarlo, a town situated about sixty miles to the N.E. of Valencia and Vinaroz, near the mouth of the Ebro, wine is fermented in the ordinary way; but in the spring of the year following, when the wine, under the influence of the increased heat, passes into a secondary fermentation, it is considered to be absolutely necessary to add spirit to prevent the alcoholic fermentation from passing into the acetous. The wine of Benicarlo intended for exportation is fortified to the extent of 5 gallons of spirit of 55 per cent. over proof per pipe, though 2½ gallons would be considered sufficient to preserve it for home use. Here also little stock is kept on hand, each year's produce being generally sold for exportation, or consumed by the time the new wine is made, so that Mr. Bernard, in 1861, could not obtain samples of natural wine from former vintages. He obtained, however, a sample of natural wine, vintage 1861, containing 23·9 per cent. of pr. sp. A wine of 1860, prepared for the English market by the addition of 5 gallons of spirit of the above-stated strength to the butt, contained 31·3 per cent. of pr. sp.

At *Alicante*, a town about ninety English miles south of Valencia, the vines are grown on the hillside and in the plain. They are the produce mainly of a kind of vine which occurs in a white and a black variety, and passes through the world under the name of Alicante. Its name at Alicante is "Tintilla." It is a large plant, with long canes; the points of the young shoots are woolly, the leaf-stalks long, the leaves five-lobed, deeply incised, uneven and puckered, light green above, woolly on the lower face. The bunch is very large, loose, hanging by a long stalk, which forms the axis, and does not give off wings or strong branches. The berries are fleshy, juicy, provided with a thick skin, and resemble much the berries of the Hambro' grapes, so well known in this country. The vine has to be cut with long canes and short spurs at the same time. The bunches must not be exposed to the sun, as the stalks have a tendency to become scorched, and to drop the grapes. The blue Alicante is immensely fertile, steady in blossom, but ripens late, so that it yields good wine only in good situations of its very warm fatherland. According to Sprenger, the red Alicante is the vine the juice of which forms the basis of most Spanish red wines. It is largely cultivated in the south of France. The white Alicante ripens somewhat earlier than the blue, but is neither as esteemed nor as much cultivated as the blue. The red wines of Alicante mostly require the addition of alcohol. Those which are intended for exportation receive from 5 to 7 gallons of Catalan spirit of 63 per cent. or 64 per cent. over proof strength to the butt. Mr. Bernard obtained two samples of Alicante (1860, Nos. 30 and 31), which he was assured were pure natural wines, free from any addition of spirit: they contained respectively 28·6 and 29·2 per cent. of pr. sp. The British Consul at Alicante informed him that a quantity of Alicante wine had in 1860 been shipped to England, to which an addition of only 3 to 3½ gallons of spirit per pipe had been made at the time of exportation, no spirit having previously been added; and that on arrival in England the whole was found to be completely spoiled.

The wines of Valencia, Benicarlo, and Alicante being rich in colour, are made up to imitate Port wine, and the casks are prepared to resemble Port pipes in size and appearance. A very large proportion of these wines, Mr. Bernard informs us, finds its way to France, for the purpose of being blended with other wines, no doubt having a large share in the imitation Ports shipped to this country from Marseilles, and in red wines from Bordeaux.

WINES OF GRANADA.

The most renowned viticultural district of this province is that of Malaga, termed Axarquia. It is very mountainous; the hills consist of clay-schist, penetrated by veins of quartz; beneath this formation there is chalk. The more solid schist is termed "herizza;" that which easily disintegrates, "lantejuéla" or "pizárra;" the latter forms the most favourable soil for the cultivation of the vine. The climate of this mountainous district is exceedingly warm and moist up to a height of several thousand feet above the level of the sea, and enables the vines to produce three crops of grapes every year. The first harvest takes place in June, and is used for raisins exclusively. The second vintage takes place in September, and yields a dry wine somewhat resembling sherry. The last vintage takes place in October and November, and gives the particular wines known as Malagas. Of these the following varieties are commonly distinguished:—1. Pedro Ximenes, made from the vine of the same name; they are delicate wines, with much bouquet, but less body than that of Xeres. 2. Coloured wines. These while young have a dark amber-colour and much saccharine. With age they lose the sweetness in part, become fine and spirituous, and acquire an extraordinary and characteristic bouquet. They are the true Malaga wines of trade, to which the place owes its reputation. They keep above a century, and do not deteriorate in bottles or casks, which are only partially filled. Their price begins with £6 per bota, and rises to £200, and higher with age. 3. Muscatel. Of these, two varieties are distinguished, namely, Malaga-Muscat and "drip" or "tear" Muscat. 4. Cherry wines, being liqueur wines, in which acid cherries or morellas have been steeped. 5. Dry white wines resembling sherries. 6. Malvasie, resembling

Madeira. 7. Tintos, coloured mostly very dark, sweet and strong wines.

Mr. Bernard obtained some samples of wines from the stores of the most extensive growers, proprietors, and exporters in Malaga. The first (No. 32) was a dry wine, vintage 1858, with 37·5 per cent. pr. sp.: the next (No. 33), a sweet wine, vintage 1857, with 29·9 per cent. pr. sp.; each of these had been treated, it was alleged, in the usual manner, by the addition of nine gallons of strong spirit, between the first and second fermentations, or in the spring following the vintage. The sample (No. 34), vintage 1847, with 37·5 per cent. of pr. sp., was given to Mr. Bernard as a peculiar and exceptional wine, having been made without the addition of spirit at any period of its production. It was alleged that this remarkable result was due to a particularly careful and extensive pruning of the vines, which had been reduced to one or two branches, and thus been compelled to concentrate their entire vigour into a few rich bunches of grapes. The story, which seemed at least very surprising to Mr. Bernard, appears to us quite incredible.

The amount of wine produced annually in the Malaga district is 80,000 arrobas, or 2,666 butts. Of these the greater part is exported, mainly to America. Much also goes to England, and the wine for both countries is prepared equally; the practice of making up wines *specially* for the English market not prevailing at Malaga.

The other wines of Spain, which we have alluded to in the first paragraph of this chapter, have not as yet been sufficiently examined for us to attempt a special description. The railways which are now being rapidly built across the peninsula, may hereafter afford us the means of obtaining ourselves the data necessary for that description.

VITICULTURAL STATISTICS OF THE DISTRICT OF XERES DE LA FRONTERA; SHOWING SURFACE OF VINEYARDS IN ARANZADAS, NAMES OF PROPRIETORS, AND QUANTITY IN BUTTS OF MUST PRODUCED.[1]

CARRAOLA.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
26	Don Andres Osisto	80
30	Herederos de Donna Juana Davila .	120
61	Don Pedro Valiente	244
4½	Donna Maria Perez	14
6	Don Juan Rodriguez	24
100	Don Manuel Morena de Mord . .	405
12	Don Francisco Avila	48
8	Don Jose Vitoria	10
48	Don —— ——	142
22	Testamentaria del Señor Marques de Meritos	100
7	Don Pedro Padilla	21
30	Don Fernando Moreno	80
18	Don Juan Arana	45
25	Don Francisco Montenegro . .	78
30	Don Ramon Chacon	105
427½		1,522

BARBAINA.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
58	Don Jose Berrio	203
40	Sra Viuda de Don Manue Trapero .	100
30	Sra Viuda de Don Jose Maria Blanco	90
30	Don Raphael Ortiz	120
9	Senora Viuda de Francisco Delgado .	24
48	Don Juan Garcia Perez . . .	50
18	Don Jose Gutierrez	60
38	Don Manuel Ponce	152
40	Don Anacleto Cepero	200
311	Carried forward	999

[1] From the evidence of Dr. Gorman before the Parliamentary Committee on Duties on Wine (1852, p. 710, *et seq.*). These statistics were approximately correct for a period dating about 1840. The great extension of viticulture since that time makes a revision of the data desirable.

BARBAINA—*continued.*

No. of Ararzadas.	Names of Proprietors.	Quantity in butts of Must produced.
311	Brought forward . . .	999
24	Don Tomas de la Quintata . . .	80
12	Donna Louisa Romero . . .	36
9	Donna Ana Romero	27
52	Don Trito Pitarte	150
38	Don Francisco Gil de parte Arroyo .	76
30	Don Hacinto Ibanez	60
8	Don Francisco Alonzo . . .	20
40	Don Luis Gonsalez de la Cosera .	100
21	Don Pablo Angulo	60
9	Don Diego Aguila	30
16	Donna Francisca de Canas . .	50
8	Don Jose Polo	20
4	Don Francisco de Cardenas . .	8
8	Don Vicente de la Torre . . .	16
3	Don Manuel Diaz	8
4	Don Juan de Molina . . .	10
6	Don Jose Jayme	12
4	Donna Beatriz Garrido . . .	8
42	Senora Viuda de Don Juan de Medina	130
6	Don Juan Garcia	18
4	Don Martin Rodriguez . . .	8
3	Don Jose Rendon	9
4	Don Tomas Codero	12
7	Don Miguel de Medina . . .	14
3	Don Antonio Cruzado . . .	9
60	Don Ramou Salaza	200
70	Donna Maria Josefa de la Puente .	210
50	Don Antonio Fajardo . . .	160
6	Don Miguel Tellez	12
15	Don Juan Jose Lopez . . .	50
30	Senor Conde de Villa Creces . .	90
18	Don Manuel Ruiz de la Rabia . .	50
70	Don Antonio Ruiz Tagle . . .	280
30	Senora Viuda de Don Pedro Merchini	60
40	Don Pedro Garcia Encina . .	140
30	Don Pedro de Sera	60
32	Don Jose de Pina	100
40	Don Fernando Rinz	120
45	Don Pedro Jose de la Concha . .	140
70	Don Juan David Gordon . . .	180
32	Don Juan Garcia	120
30	Don Miguel de Giles . . .	80
80	Don Juan Estevan Apalategni . .	320
20	Don Melchior Marguer . . .	50
70	Don Justo Goni	140
8	Herederoz de Don Andres Diaz .	24
10	Don Jose Maria Buendia . . .	25
30	Don Pedro Rafael Sorela . . .	50
12	Don Antonio Rodriguez . . .	18
1,566		4,649

SAN JULIAN AND RUIZ DIAZ.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
30	Don Carlos Benvinuti (su viuda) .	100
20	Herederos de Don Alberto Fortan .	50
24	Viuda de Don Ramon Mariscal . .	48
30	Don Antonio Amador . . .	50
7	Don Francisco Morales . . .	14
40	Don Manuel de Pina	140
50	Don Juan Gonzalez	120
30	Don Francisco de Paula . . .	60
13	Don Juan Copero	39
16	Don Juan Aguilar	48
50	Don Manuel Luis Fernandez . .	130
20	Don Juan Diaz	60
20	Don Jose Sanchez	80
20	Viuda de Don Pedro Sanchez . .	50
5	Don Manuel de Nieves . . .	20
5	Don Juan de Nieves	20
17	Don Juan Cabrera	45
18	Don Jose Martinez	60
60	Don Juan Jose Maderne . . .	240
37	Don Lucas Caballero . . .	110
16	Don Jose Maria Villavisencio . .	48
18	Don Angel Martinez . . .	60
30	Don Jose de la Rosa y Miranda .	120
30	Herederos de Don Julian del Villar .	120
35	Don Jose Albarez	70
13	Don Jose Moreno	40
15	Don Jose Garcia	40
15	Viuda de Don Jose del Toro . .	45
60	Don Jose Madero y Parodi . .	132
60	Donna Josefa Gregoria de la Casa y Piedra	180
30	Don Sebastian Heredero . . .	110
4	Don Jose Duarte	36
12	Don Nicolas Padilla . . .	8
50	Sres Lacoste y Capdepon . . .	150
900		2,643

CORCHUELO.

No of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
32	Don Pedro Lopez Ruiz . . .	100
18	Donna Josefa Carmona . . .	50
35	Don Manuel Ramirez de Cartagena .	100
30	Don Agustin Romero . . .	80
7	Don Cristoval Savorido . . .	25
122	Carried forward . . .	355

CORCHUELO—*continued.*

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
122	Brought forward . . .	355
6	Don Diego Reguina . . .	15
12	Viuda de Don Francisco Garisa .	36
16	Don Francisco de Morales . .	40
6	Donna Juana Garisa	12
6	Don Jose Blanco	16
4	Don Francisco Perez . . .	12
17	Donna Isabel Canchola . . .	50
10	Don Diego Rodriguez . . .	40
13	Herederos de Don Cristoval Lizano .	38
5	Don Fernando de Puertas . . .	20
13	Don Manuel Melero	39
9	Don Manuel de Huertas . . .	30
30	Don Pedro Requelme y Novela . .	60
40	Don Francisco de Salas . . .	120
14	Don Bartolome Lopez . . .	45
30	Don Antonio Perez	100
14	Don Juan Jose Ceballos . . .	34
9	Donna Juana Garrido . . .	27
9	Donna Buenaventura Arana . .	30
7	Don Francisco Sereno . . .	21
6	Don Salvador Jimenez . . .	24
8	Don Pedro Gutierrez . . .	30
12	Viuda de Don Juan Blanco . .	36
20	Don Jose Ruiz de Castillo . . .	60
24	Don Juan Lomoa	80
19	Don Jose Orrantia	60
9	Don Pedro Alvarez	30
8	Don Pedro Cantillo	20
30	Don Manuel de la Torre . . .	60
20	Don Nicolas Gamboa . . .	60
8	Herederos de Don Tomas Jimenez .	16
24	Don Francisco de Cala . . .	60
8	Don Juan Garron	30
6	Don Pedro Zerrudo	24
594		1,730

ANINA.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
15	Don Juan Jose Maderne . . .	45
40	Don Pablo Gonzalez . . .	120
15	Don Jose Fernandez y Hermanos .	50
30	Don Hipolita Avela	120
10	Don Bernabe Franco	30
8	Don Pedro Cardoso	16
20	Don Ramou Lorente . . .	40
27	El Marques de Campo Real . .	80
24	Don Juan Marquesi	60
189	Carried forward . . .	361

ANINA—*continued.*

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
189	Brought forward	361
12	Viuda de Don Francisco Morales .	24
52	Don Joaquin Rivero	150
22	Herederos de Don Francisco Avila .	50
17	Don Angel Velarde	60
20	Herederos de Don Jose Leon . .	80
10	Don Gregorio Sanchez Bustamente .	30
12	Don Fernando Benites . . .	50
17	Don Sebastian de Morales . .	60
20	Don Francisco Montenegro . .	48
17	Don Pedro Cantillo	50
40	Don Ignacio Sanchez Bustamente .	120
32	Don Julian Lopez	110
13	Don Pedro Richart	50
40	Don Juan Salazar	200
24	Don Pedro Rodriguez . . .	100
25	Herederos de Don Jose Gutierrez Valle	100
12	Don Manuel de Sierra . . .	30
10	Don Domingo Fernandez . . .	40
7	Don Juan Villegas	35
12	Don Fernando Villegas . . .	60
7	Don Pedro Lopez Malo . . .	28
17	Don Jose de Pina	70
10	Don Jose Regife	40
10	Don Juan Tarquin	50
50	Don Luis de la Cuadra . . .	200
60	Don Jose Adorno	240
30	Donna Francisca Hontoria . .	90
17	Don Sebastian Benitez . . .	90
12	Don Francisco Rubiales . . .	48
12	Don Antonio Padilla . . .	40
828		2,904

TOCINA AND PUERTO ESCONDIDO.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
3	Don Jose Barrera	12
3	Don Antonio Gonsalez . . .	12
13	Don Manuel Alcedo . . .	40
5	Don Francisco Gonsalez . . .	20
6	Don Manuel Corchones . . .	12
5	Don Domingo Rodrigues . . .	15
24	Don Mateo Balbas	80
12	Don Jose Aguilera	30
8	Don Juan Camacho	20
6	Don Francisco Laso	16
3	Don Antonio Padilla . . .	9
16	El canonigo Zurita	40
8	Don Cristoval Cortes . . .	32
65	Don Manuel Juan Calvo . . .	350
177		688

LAS PEONIAS.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
40	Don Antonio Sanchez	120
50	Don Luis Oneale	150
40	Don Jose Quijano	120
72	Don Jose Colon	420
40	Don Jose Sanz	200
40	Don Francisco Peregil	120
30	Don Antonio Garcia	120
40	Don Manuel Alvarez	80
100	Don Isidoro Castrisione	600
452		1,930

CERRO DE SANTIAGO.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
20	Don Diego Orbaneja y Roy . . .	60
70	Don Francisco Orrantia	350
6	Don Jose de Vargas	9
6	Don Maria de Vargas	12
60	Viuda de Don Julian Pemartin . .	100
12	Donna Ines Rodriguez	36
30	Don Antonio Barbado	100
24	Don Pedro Rafael Sorela	40
6	Don Geronimo Garisa	18
12	Don Jose Garisa	50
11	Donna Maria de Huertas	40
257		815

CERRO DEL PELLADO Y TIZON.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
6	Don Melchior Franco	12
10	Don Cayetano Perez	30
30	Donna Luisa Ponce	60
24	Don Juan Ortez	50
5	Don Juan Grajales	15
40	Herederos de Don Pedro Simo . . .	120
5	Don Domingo Paradas	15
6	Don Jose Gamero	18
24	Don Miguel de Giles	70
16	Don Jose Pounjilione	50
6	Viuda de Juan Triano	18
20	Don Jose Guisado	60
192	Carried forward . . .	518

CERRO DEL PELLADO Y TIZON—*continued.*

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
192	Brought forward . . .	578
60	Herederos de Don Juan de Mendoza .	150
30	Donna Maria de Jesus Davila . .	90
6	Don Juan de Moya	24
38	Senor Marques de Casa Vargas . .	150
25	Donna Maria Lopez	60
6	Don Juan Munoz	18
20	Don Juan Rendon	30
30	Don Josefa de Matos	100
8	Don Jose Capano	24
40	Don Cayetano Rivero	120
6	Don Diego Copano	16
24	Donna Maria de Consolacion Sanchez	60
11	Don Juan Quijal	30
4	Don Juan Cabrera	12
4	Don Juan Gonsalez	20
4	Don Cayetano Garcia	15
30	Don Silvestre Gutierrez . . .	90
24	Don Pedro Rechar	60
10	Herederos de Donna Ines Munos .	28
5	Don Manuel Brito	15
30	Don Joaquin de la Torre . . .	60
40	Don Manuel Sanchez Silva . .	120
20	Don Juan Sisto Oronoz . . .	30
40	Don Francisco Sanchez Ibera . .	130
707		1,970

MACHARNUDO, ALTO Y BAJO.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
80	Don Jose Aranda	190
4	Don Francisco Munoz	12
3	Don Antonio Munoz	12
4	Donna Isabel Gusman	12
6	Don Cayetano Garcia	24
40	Don Jose Moreno	130
13	Herederos de Don Jose de la Cega .	39
7	Don Jose Fernandez	21
12	Donna Elvira Moreno	40
18	Don Domingo Miran	60
20	Don Rafael Garcia	50
24	La Viuda de Bermudez	60
49	Don Jose Paul	100
4	Don Diego Cano	12
14	Don Jose Rivas	50
40	Don Jose Cosio	80
12	Herederos de Don Tomas Rendon .	24
30	Don Manuel Calvario	50
32	Testamenta de Don Francisco Sacarron	66
30	Testamenta de Don Ana Alonso Arias	60
30	Donna Joaquina Davila . . .	90
472	Carried forward . . .	1182

MACHARNUDO, ALTO Y BAJO—*continued.*

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
472	Brought forward . . .	1182
6	Don Antonio Diaz	18
6	Don Jose Diaz	15
50	Don Diego de Lara	120
10	Donna Francisco Pica . . .	24
10	Don Jose Cortes	30
60	Don Juan Garcia	180
460	Herederos de Don Pedro Domecq .	1,200
18	Don Pedro Ardila	60
60	Don Diego Orbaneja y Perez . .	150
50	Don Rafael Ribero de la Tijera .	130
22	Don Rafael de Fuentes Cantillana .	80
30	Donna Mariana de Medina . .	90
38	Viuda de Don Francisco Perez Munoz	120
8	Don Raman Martinez	24
30	Don Pedro Padilla	90
10	Don Jose Garcia	40
7	Don Juan Lopez	21
30	Don Jose Garrafa	90
6	Don Juan Rejifo	24
8	Don Benito Aguado	40
17	Don Jose Rejifo	34
30	Don Juan Perez Becerra . . .	80
70	Don Simon de la Sierra . . .	280
25	Don Pedro Letran	70
10	Donna Josefa Rosendo . . .	30
40	Don Tiburcio Ochoteca . . .	150
40	Don Juan Rendon	80
100	Don Manuel Domecq	300
6	Don Juan Naranjo	24
6	Bartolomé Naranjo	24
10	Don Juan Franco	30
30	St. Conde de Montejil . . .	100
90	Herederos de Don Miguel Esteves .	350
30	Don Roberto White	75
1,895		5,355

CARRASCAL.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
10	Don Diego Sanchez Barreno . .	40
16	Don Juan Fontan	80
32	Don Antonio Arron	160
34	Don Francisco Perez Cepero . .	136
28	Don Francisco Fernandez . . .	84
30	Don Jose Alvarez Patiño . . .	120
40	Don Vidal de Paramo	80
10	Herederos de Don Tomas Cordero .	20
13	Don Juan Lopez Cepero . . .	39
5	Don Pedro Gaudon	12
218		771

CARRASCAL—*continued.*

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
218	Brought forward . . .	771
6	Don Francisco Aparcero . . .	9
17	Don Juan Blanco	40
24	Don Tomas de Castro . . .	60
17	Don Juan Perez	50
17	Don Francisco de Paula Palacios .	40
85	Don Manuel Monti y Diaz . .	255
6	Don Francisco Leal	15
14	Don Jose Fantoni	42
30	Don Juan Francisco Alduncin . .	120
15	Don Francisco Franco . . .	30
37	Don Francisco Rabin de Celis . .	111
5	Don Jose Camacho	15
5	Don Francisco Conde . . .	14
5	Don Miguel Conde	16
8	Don Antonio de Pasos . . .	32
4	Herederos de Don Cayetano Quintero	12
30	Viuda de Don Juan Otero . . .	80
32	Don Patricio Garvey . . .	96
15	Viuda de Don Jose Gallardo . .	45
20	Don Sebastian Gonsalez . . .	40
20	Don Manuel Romero . . .	60
40	Don Jose Martinez	50
5	Don Ignacio Suarez	12
4	Donna Francisca de Molina . .	9
4	Donna Catalina Rodriguez . .	10
13	Don Jose Maria Crespo . . .	30
50	Don Jose Lacaste	150
28	Don Francisco Maria Perez y Gomez	56
31	Senora Marquesa de Villamarta .	93
14	Don Benito Rivero	35
18	Don Jose Caballero	72
30	Don Jose de la Rosa . . .	120
17	Herederos de Don Cristoval Villegas	59
40	Donna Feliciana Abad Romano .	110
30	Don Antonio Gonsalez . . .	102
30	Don Francisco Perez de la Riva .	110
8	Don Jose Casao	16
9	Don Francisco Paula Palamino . .	18
5	Don Simon Lopez	20
5	Don Domingo Gonsalez . . .	20
5	Don Jose Galvez	16
6	Don Sebastian Cabecas . . .	24
6	Don Juan Gonsalez	18
6	Don Francisco Sierra . . .	18
10	Don Carlos Lidier	24
4	Don Miguel Martinez . . .	12
6	Don Juan del Cerro	18
10	Don Jose Gonsalez	30
30	Don Pedro Manuel de la Camara .	120
35	Viuda de Don — Elias . . .	95
30	Don Jose de la Concha . . .	90
7	Don Francisco Medina . . .	21
30	Don Manuel de la Torre . . .	70
30	Don Diego de Lara	60
1,226		3,661

ESPARTINA.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
60	Viuda y herederos de Don F. Amador	180
18	Don Francisco Besada . . .	44
12	Viuda de Don Domingo de los Rios .	24
7	Don Francisco Alonso . . .	21
38	Don Juan Duran	114
19	Don Jose Perez de la Sierra . .	76
30	Don Jose Pomar	120
35	Don Geronimo Angulo y Davila .	140
219		719

DUCHA.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
60	Don Juan David Gordon . . .	260
27	Don Hipolito Abela	108
50	Don Jose Gonsalez y Gonsalez . .	200
24	Don Mariana de Medina . . .	92
35	Viuda de Don Pedro Grajales . .	120
40	Don Estevan Bracho . . .	140
49	Don Tomas Haron	120
285		1,040

CUARTILLO.

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
5	Don Pedro Serrano	16
4	Don Gonsalo Quiroz . . .	16
4	Don Juan Suarez	16
8	Don Francisco Molina . . .	32
6	Don Antonio Arroyo . . .	22
6	Don Juan Quintero	18
9	Don Andrea Jarquin . . .	38
6	Don Blas Barro	24
24	Viuda de Don Gonzalo Sanchez .	48
72	Carried forward . . .	230

CUARTILLO—*continued.*

No. of Aranzadas.	Names of Proprietors.	Quantity in butts of Must produced.
72	Brought forward . . .	230
18	Don Alonso de Vargas . . .	40
6	Don Francisco Ramirez . . .	18
4	Don Bartolomé Baez . . .	16
5	Don Antonio Algaria . . .	18
7	Don Pedro Barba	28
5	Don Tomas Fernandez . . .	15
4	Don Diego Garisa	12
10	Don Juan Suarez	40
4	Don Pedro Cabrera	16
4	Don Juan Galan	12
3	Don Manuel Munoz	10
3	Don Pedro Carmona . . .	12
5	Don Francisco de Medina . .	20
6	Don Andres Fernandez . . .	18
6	Don Jose de Morales . . .	24
5	Don Antonio Ruiz	20
16	Viuda de Don Pedro Pino . .	48
10	Don Juan de Lara	40
6	Don Luis Alcedo	18
24	Don Augustin Perez de la Riva . .	72
6	Don Juan Andrade	24
10	Don Juan Romero	50
6	Testamentaria de Don Francisco Gutierrez	24
4	Don Antonio Goyno . . .	12
14	Don Geronimo Garisa . . .	56
4	Don Benito Moreno	16
6	Don Jose Tamayo	24
13	Donna Maria Garcia . . .	60
6	Don Francisco Espinosa . . .	9
8	Don Diego Cruzado	32
9	Don Juan Fernandez . . .	36
6	Don Domingo Fernandez . . .	24
3	Don Miguel de Cala	12
14	Donna Maria de los Angustias Sauchez	50
8	Don Jose Guillen	16
7	Don Jose Fernandez	40
8	Don Juan Gabriel	45
6	Don Martin Fernandez . . .	24
9	Don Miguel Florinda . . .	36
10	Don Eugenio Bernal . . .	50
5	Don Augusten Vasquez . . .	15
6	Don Jose Gonsalez	20
50	Don Manuel de Veas . . .	200
60	Don Fulgencio Perea . . .	240
501		1,842

TWELVE SMALL VILLAGES.

Names of Villages.	Aranzadas.	Butts of Must.
Colores	40	160
Palmosa	68	340
Torros	242	486
Anajeras	60	180
Bonayna	90	360
San Cristoval	50	150
Mata Cardillos	40	160
Gibalcon	124	372
Cibullo	30	90
Parpalana	120	360
Caldereras	112	448
Zolete	161	644
	1,137	3,750

PAGOS DE BARRO (CLAY DISTRICT).

Names of Villages.	Aranzadas.	Butts of Must.
Montealegre	403	1,209
Valdeltoro	332	996
Mesa de Da Rosa	33	99
Fuente de Pedro Diaz . . .	51	204
Geraldino y la Granja . . .	80	320
Bogas	67	181
Rabo Atun	112	448
	1,078	3,457

PAGOS DE ARENA (SAND DISTRICT).

The wines grown in these villages are consumed by the people.

Villages.	Caretadas de Verdea.	No. of Aranzadas.
Fuente de la Feja	168	42
Piedre de Mirabas	117	39
Pago del S. José	180	60
Picaduenas	168	82
Santa Fe	180	45
Cruz Colorada	117	39
Carried forward . . .	930	307

PAGOS DE ARENA (SAND DISTRICT)—*continued.*

Villages.	Caretadas de Verdea.	No. of Aranzadas.
Brought forward	930	307
Herseria	123	41
Arroyo del Membrillo	284	71
Valde Pajuela	240	80
Pie de Rey	70	19
Pinar de Alcazas	171	57
Largalo	1,680	420
Caulina (Abiertos)	320	80
Peliron	400	100
Perreba	904	226
Llano del Matadero	125	25
Canaleja	250	70
	5,497	1,496

GENERAL RÉSUMÉ OF THE ABOVE ENUMERATED PAGOS, THEIR ARANZADAS OF VINEYARDS, AND THEIR PRODUCTION OF MUST IN BOTAS.

Pagos.	No. of Aranzadas.	No. of Botas.
Carraola	427½	1,522
Barbaina	1,566	4,649
S. Julian	900	2,643
Corchuelo	594	1,730
Anina	828	2,904
Puerto escondido y Tocina	177	688
Las Peonias	452	1,930
Cerro de Santiago	257	815
Cerro del Pellado y Tizon	707	1,970
Macharnudo	1,895	5,355
Carrascal	1,226	3,661
Espartina	219	719
Ducha	285	1,040
Cuartillo	501	1,842
	10,034½	31,468

CHAPTER XXI.

THE WINES OF PORTUGAL.

Topography of the port wine district.—Valley of the Douro.—Upper and Lower Corgo.—Preparation of soil on the Douro.—Varieties of vines grown on the Douro.—Mode of cultivating the vine.—Vintage and modes of vinification.—Jeropiga.—Remarks on vinification on the Douro.—On the addition of brandy to port wine.—Description of a natural dry Alto Douro wine.—Spectrum of pure port wine.—The elder-tree on the Douro.—Spectrum of elderberry juice.—Historical notes of the port wine trade.—Value of port wine.—White port.—Possible extension of production of port wines.—Alphabetical list of the principal places in the districts of the Alto Douro.—Other wines of Portugal.—Description of a wine called "Consumo."

TOPOGRAPHY OF THE PORT WINE DISTRICT.

THE river Douro issues from Spain, crosses the northern part of Portugal in a westerly direction, and flows into the Atlantic Ocean in the bay of Porto. To the north of this bay, and about three miles inland from the ocean, lies the town of the same name, also called Oporto, and to the south of it the suburb Villa Nova.

The wine districts of the Douro begin at its entrance into Portuguese territory. But here in the highest part the area of cultivation is yet limited, and the conformation of the soil not so favourable as in the middle of its course. It is on both sides of a tributary of the Douro which comes from the north, the river Corgo, that the cultivation of the vine is more extended, and, as regards the production of a particular class of wine, most successful.

The district which had the most ancient cultivation is that west of or below the river Corgo, usually termed the Lower Corgo. This begins at a distance of about forty-two miles English above Oporto, and occupies the triangular space between the Douro and Rio Corgo. The entire valley of the Rio Corgo properly belongs to the district, but the part east of the river is small in comparison to the western section. As the demand for port wine increased, cultivation ascended the Douro, until it occupied the whole of the available soil of an area extending about thirty miles English along both banks of the Douro, from east to west, and ten miles from north to south, including the valleys of the Corgo, the Penhao, and some smaller rivulets.

The part east of the Corgo ending near the river Taah, is termed the Upper Corgo. Here the soil is not very deep, but very stony, more nearly resembling the *débris* from a stone quarry, and produces a very dense must. In the Lower Corgo the soil is generally deeper and more loamy, and the country less mountainous than in the upper. The soil in the entire district is the product of the disintegration under the influence of the atmosphere of a brown, slaty schistose rock, which forms a great number of lofty and precipitous hills. A great extent of the district known as the wine country is not susceptible of any other cultivation but that of the vine.

PREPARATION OF THE SOIL ON THE DOURO.

The exceedingly stony nature of the soil throughout the district, and particularly in the Upper Corgo, renders the use of the spade impossible; and even the ordinary hoe, the general implement of hand-labour in Portugal, cannot be employed in the wine district. The tool used is a hoe (*euxada*) having two strong prongs instead of the usual cutting part, and a heavy mass of iron on the opposite side. With the forked part the soil and the large stones in the vineyards are turned over; with the other they receive one or two blows, which break them up, and expose their fragments to the decomposing action of the atmosphere.

The average daily wages, with food supplied, are, for a vine-dresser, 1*s.*; for a common labourer with the hoe, from 8*d.* to 10*d.*

VARIETIES OF VINES GROWN ON THE DOURO.

There are a great variety[1] of vines grown in the district; some give delicate grapes, producing light and delicate wine. Each section has again its peculiar set of vines, differing in the character of the wine they produce. The *Souzão* grape imparts the darkest colour of all the Douro grapes used for wine; but the wine requires much brandy for its preservation, and is deficient in bouquet and flavour.

The *Verdeilho* yields a fine peculiar wine. It is the vine which Australian settlers have selected from the sets of the Douro for their distant plantations.

The *Mourisco,* a grape producing a wine with body and colour, but coarse.

The *Bastardo* is a vine much grown in the Lower Corgo, and a type of all the species there cultivated. It produces fine wine, of delicate flavour, but with little colour.

The *Alvarilhao* is also frequently used in the Lower Corgo.

The vines which form the general sets of the vineyards in the Upper Corgo are not so fertile, but the wine obtained from them has more body, a very full colour, and a remarkable but coarse flavour. The most frequently cultivated varieties are—

The *Touriga.*

The *Tinta Francisca* (probably the teinturier).

The *Tinta Caa.* The two latter varieties are mainly grown for the sake of their colouring matter.

MODE OF CULTIVATING THE VINE.

The vines are grown close to the ground, but not creeping over it, nor supported on pollards (trees with shortened branches) or trellises as in most other parts of the Peninsula. This culture is the most economical and the most rational for the production of good wine. The vines are cut very

[1] In the collection of the Royal Horticultural Society at Chiswick is a vine labelled "Port wine or Claret," viz. the vine. This requires a better diagnosis.

short, so that each of the two or three or more main branches of the vine is allowed but two or three eyes for the bearing branches, and one eye with the subsidiary small eye for the growing of wood. It is the same cut as that in the best situations of the Rheingau, with the exception of the long bow, which is not frequently used on the Douro. Stakes are used here and there.

VINTAGE AND MODES OF VINIFICATION.

The vintage generally takes place during the time between the 29th of September and the 10th of October. This is a very late period for so southern a climate, and indicates at once that the grapes are allowed to hang on the vines for some time after they are actually ripe, in order to produce a concentration of their juices. At the time of the vintage great numbers of labourers flock to the wine country from the adjacent villages and from Gallicia, hence called Gallegos; amongst these, women and boys preponderate. Their wages are on an average *7d.* a day and food, which, however, does not include bread. Many of the vine-growers make wine themselves; others sell their grapes to the manufacturers. The larger houses, particularly the English firms, engaged in this trade, are the most careful in their processes. However, there are here all kinds of processes and utensils in force, such as are known in other lands producing red wine. The grapes are trodden by men on platforms, and the juice, mixed with the stalks and husks, is removed to stone-built vats (Portuguese, "Lagar"). The process of removing the stalks is not practised. Hence all port wine (particularly in years where the stalks are not dry and shrivelled) has a great amount of astringency, which requires much time for its partial subsidence and modification. When the fermentation has so far proceeded that the amount of alcohol formed counterbalances the specific gravity of the remaining sugar, so far as to bring the glucometer to the zero-point, the fermenting mass is greatly agitated, either by means of tools or by men, who go into the vats naked. The stalks and husks are now mixed with the new wine so intimately that most of the colouring matter is extracted from the husks. This done, the wine is immediately drawn off by pumps, syphons or taps, always guarded inside by some kind of filter, and placed into tonnels, varying in capacity between five-and-thirty pipes.

In good years, when the must contains more sugar than can be decomposed by a first fermentation, the addition of brandy to newly-drawn wine completes the first preparation; but in years in which sugar is deficient, this, as well as alcohol, and not rarely colouring-matter, have to be supplied. Latterly the cane and beet-root sugar of commerce are taken for this purpose, and become converted, if added at the proper time, into grape-sugar, or artificial grape-sugar is added as such. But a common process is still the evaporation of a portion of the must, and the addition of the syrup so obtained to the other natural portion of must. Colouring-matter is supplied to grapes, which seem to require it, by sprinkling them during the process of treading with the necessary amount of dried and powdered elderberries, or a particular kind of black-coloured cherries. It must be understood that in good years grapes contain a sufficient amount of colouring matter to give to the wine the desired tint: particularly when there is a sufficient admixture of the "Tinto" vine in the set of the vineyard, extraneous admixtures become unnecessary even in middling years. But in a few of the very best years the port wine assumes a sickly brownish red colour, which has to be improved in tone by the admixture of something more purple, and then anything is resorted to, from elderberries and cherries to extract of Brazil-wood. These improvements, however, take place later, and not during the process of vinification.

The wine is left in the tonnels until the cold weather of the autumn arrests what little fermentation the addition of brandy had allowed to go on. Towards the middle of November the wine has deposited its lees; and, being now clear and bright, is drawn off into pipes, containing each 115 gallons. In this state it remains in the sheds and cellars of the Douro district until the early spring of the following year. It is then brought by boats down the river Douro, and stored in the warehouses or lodges of the merchants at Villa Nova and Oporto.

JEROPIGA.

The term is applied most commonly to what is called a *vinho mudo;* that is, a must checked at the height of its fermentation by the admixture of 32 per cent. of proof spirit. It is still occasionally made of the pure sweet must, unfermented, with the addition of brandy. Frequently the must is evaporated to a syrupy consistence, mixed with more natural must, and then mixed with brandy. These preparations constitute jeropiga, absolutely so called. Another kind of jeropiga is the coloured, or *tinta;* and this is always coloured with extraneous dyes, mostly elderberries. Forrester described a variety of it, as compounded of treacle, unfermented grape-juice, elderberry, and brandy. The true jeropiga is added to wines requiring sweetness. The jeropiga tinta is used for doctoring common port wines. Much of it goes to the United States under the name of "pure juice," and is there consumed in negus.

REMARKS ON VINIFICATION ON THE DOURO.

The great fault of all port wine preparation is deficiency of care during the first vinification. However careful the merchants may be in the lodges, they can never hope to make up for primary faults. Although some makers pick the grapes, so as to remove the bad and unripe ones, this precaution is by no means general. The stalks are not removed before crushing the berries. This ought to be done everywhere. The simple machine described in the general part, or even manipulation with a plain sieve, are quite effectual. The stalks, if dry, do less mischief; but they soak again during fermentation, and give out astringent matter. The precaution of treading the grapes is mainly directed against the communication of astringency by means of crushed stalks and kernels. This danger being completely obviated by the use of india-rubber rollers, there remains removal of the kernels before fermentation. A complete reform of port wine making might be undertaken to the following extent and effect:—The berries having been squeezed through the india-rubber rollers, are to be gently pressed, and deprived of all flowing juice. The husks are next to be picked (by children's and women's hands) free from all fleshy particles and kernels, and immediately packed in brandy-syrup in earthen or wooden vessels, or barrels. The juice should, meanwhile, stand at rest in high vats, so that the impurities can deposit and the froth can rise. The vats should be so arranged that the froth can be skimmed off, either by tilting or otherwise, and that the clear must can be drawn off the deposit. To the clear juice thus purified from all matters which can readily engender putrid fermentation, and spoil the wine for many years, the husks, together with the brandy and sugar in which they are preserved, should now be added. After the whole has been well mixed, a sample of the juice should be analysed by an experienced person, as to acidity and amount of sugar. The acidity should not be more than 7 in 1,000 of must. The sugar should not be less than 20 parts in 100 of must. Any excess of acid or deficiency of sugar should be remedied by the proceeding described in the general part. No plaster or lime should under any circumstances be added to grapes, must, or wine, as it is sure to cause a great loss to the proprietor, if employed in sufficient quantity to effect anything.

ON THE ADDITION OF BRANDY TO PORT WINE.

No port wine comes to England that contains less of adventitious brandy than half an almude, or 16 quart bottles, or nearly three gallons to the pipe. But the heavy-brandied so-called rich wines contain from 15 to 17 gallons of adventitious brandy in each pipe of 115 gallons.

The principal reason for the addition of brandy to port wine is this, *that it is the quickest and most certain means to make the wine marketable and saleable to the consumer.* The wine is not made *drinkable* any earlier than it would have been without the addition of brandy; on the contrary, it would have matured quicker in its natural state. But the brandy brings it into a quiescent condition; it is not liable to any subsequent little fermentations; it may be exported to climates hot and cold; in other words, with 40 per cent. of proof spirit in it, port wine will keep. But it tastes of spirit of wine, and must, therefore, be kept six or eight years in bottle before it loses the taste of spirit of wine or brandy, and regains the roundness of wine.

If no brandy were added to port wine, the following occurrences would take place with *wine of good* years:—It would ferment slightly every spring and summer, and become turbid. If not properly attended to during or after this fermentation, it would lose flavour and quality, also colour; if properly attended to, it would much improve. It could not be bottled before five or six years after the vintage, as, if the after-fermentation occurred in the bottles, it would be much deteriorated. It could not be shipped in casks before five or six years, because, if fermentation occurred during the voyage, it would be ruined. The cask might burst or leak; a void would form in it; air would enter; the disturbed lees would form vinegar-fungi, and acetous fermentation would begin or accomplish the ruin of the wine. All these occurrences would be matters of course and natural necessity. With *the wines of bad years* the occurrences would be similar, but more certain in result, and other accidents would be superadded. Thus the wine would become viscid, or bitter, or shed its colouring matter to a great extent. More liable to spoil simply, it would be less liable to mere fermentation. None of these accidents could occur to wine made upon our own plan, without brandy.

If the Oporto wine-producer or merchant added no brandy to his wine, he would be obliged to keep it for five, six, even seven years, before he could safely ship it. But the addition of brandy enables him to ship the wine three or four months after the vintage, if so inclined, or during any period succeeding that time. Thus the producer and merchant shift the onus of maturing the wine upon the consumer. This is no hardship to the provident consumer, or to him who is rich enough to lay in stocks ten years before they are required; but to the mass of the population, who are not thus fortunately situated, this circumstance is a hardship. They never get good port wine to drink: for the capitalists, who lay in large stocks of bottled port, work mostly for established custom; and the uncertainties of the trade, the rigidity of circumstances produced by the former mismanagement of the customs' duties, have prevented them from speculating, and require them to take enormous profits to cover possible losses. As these houses did not retail, and as there were almost no retailers known in whom the public could have had confidence, the middle-class of moderate but regular means abandoned wine as a means of agreeable domestic living, and reserved the port they could obtain for occasions of social intercourse. Much of the brandy used with port wine is distilled from common wines of Portugal produced out of the Douro district, of which nine pipes give one pipe of brandy; but many thousands, up to 12,000 pipes, are annually carried to Portugal from Great Britain to be used in the manufacture of port wine and jeropiga. If the manufacturers of port wine did not use brandy, they would be obliged to mature their wines in deep cold cellars, of which they have not any at present sufficiently capacious to hold even a small proportion of their stock. The natural port could not with advantage be matured in the present structures called lodges. Of course, if the merchants had to keep all their wines until ripe without brandy, their capital would be engaged much longer, and their operations would, consequently, be much contracted. The consumer would not pay more than he pays now; on the contrary, he would pay rather less, for obvious reasons. It is therefore clear that, as long as the makers and merchants can sell their port wine as at present, they will continue to make it as hitherto. But should a new method be found by which port wine can be matured in less time than with the addition of brandy, there can be no doubt that such method will be used by many, and the public will be then able to obtain the natural wine at more moderate cost. In corroboration of this we may state that one of us has lately examined several varieties of red Portuguese wine sold in London, one of which, an Alto

Douro vintage 1869, yielded the following results to chemical analysis :—Specific gravity of wine = 990·6 ; specific gravity of dealcoholized wine = 1012·7 ; specific gravity of distillate directly, 977·8, equal to 14·91 per cent. of alcohol by weight in volume of wine. Distillate calculated = 977·9, equal to 14·83 per cent. of alcohol. Free acid in 20 c.c. of wine = 13·5 c.c. $\frac{1}{10}$ normal soda ; fixed acid = 10 c.c. Subjected to spectrum analysis, it exhibited the unique feature of a specific absorption colour spectrum, of which the following is a description. A layer of from six to seven millimètres in thickness allows red to pass to about forty-six of the scale adopted by one of us.[1] Then an absorption band is perceived overlying the region of the D line, and beyond that a feeble light in green. Blue and violet are entirely extinguished. On dilution with alcohol (water has to be avoided, as it produces a precipitate in the wine), the absorption band measures from 59 to 88 of the scale quoted, and has intensity 4. The following diagram illustrates these appearances. The taste of this wine was very

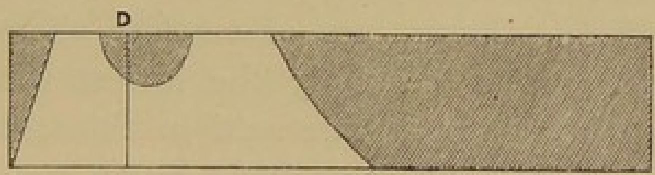


FIG. 84.—Diagram of spectrum of Alto Douro wine.

fine, full, pure, and extremely characteristic. It was fine, because it was evidently made from the finest and ripest Alto Douro grapes, the Verdeilho and Bastardo ; it was full, owing to its great vinosity and high amount of natural alcohol, yet free from adventitious syrup or jeropiga ; it was pure, because free from all those faults which depreciate so many southern wines, such as the propionic and fousel flavour, or the burning taste of distilled spirit. It was extremely characteristic in this, that, besides all these great qualities,

[1] Thudichum, "Researches intended to promote an improved Chemical Identification of Diseases :" *Eleventh Report of the Medical Officer of the Privy Council* for 1867.

it possessed the very essence of port wine flavour, without the saccharine and spirit commonly found in port wine, and had a natural smooth astringency, such as pleases the palate and imparts keeping qualities. This wine was indeed very unlike the artificial sweet and burning products commonly called port wine, and constituted, as nearly as can be, a natural wine. It was certainly thoroughly fermented, and contained only that minimum of grape-sugar present in all young wines, which is only found by chemical and optical analysis, but escapes the taste. It was perfectly dry, and thereby differed from current port wines which contain from 2 to 6 per cent. of sugar. Its alcoholicity was certainly below the maximum which a natural wine is capable of attaining, being 14·83, while the limit is 16 per cent. But from investigations which we have instituted it follows that the alcoholicity of port wine, which we have reason to believe to be perfectly natural, has 9 per cent. as the lowest, and 13·8 per cent. as the highest limit. Consequently, it is probable that from $1\frac{1}{2}$ to 2 per cent. of alcohol had been added to this Alto Douro wine, perhaps as is commonly done with Burgundies, during the process of vatting. The alcoholicity of this Alto Douro is certainly the lowest which we have ever met with in any port wine sold in this country. Only in one instance did we find as little as 15 per cent. alcohol in a sweet high-priced old port. All our other numerous analyses gave from 16·5 to 19·2 per cent. alcohol in sweet ports, or from 36·6 to 42·5° of proof spirit. Consequently, besides all its other good qualities, the Alto Douro here described had this distinction, that it contained the lowest amount of alcohol amongst all the genuine port wines sold in this country. It possessed high dietetic and hygienic qualities, and refreshed like Burgundy or Médoc wine, while having more body than either of these, and fully bore out all that the late Baron Forrester stated in praise of natural Douro wines. When compared to Burgundies or Médocs of the same price, it gained an easy victory. We are glad to find that such port wine has now become a staple article of a distinguished commercial enterprise.

Mr. Consul Crawfurd asserts that the wines of the Douro, when made without brandy, have not any of the softness or flavour of port wine, but are intermediate in character between claret and burgundy, without possessing either the delicate bouquet of the one, or the flavour and roundness of the other. Against this very positive but nevertheless erroneous assertion, it must be remarked that natural Douro wine, from a good vineyard, made in a good year, can have no such similarity to either claret or burgundy as would ever make it stand intermediate between them. The varieties of vines prevent the occurrence of any such similarity. Natural port wine tastes peculiar; and if there is anything nearer to us than itself, that is like it, it is the best Montpellier, kept five years, three in bottle. That most people in England would not recognize natural port of the best quality we readily believe: but then the people are learning more and more to appreciate the fact that there are many wines of many tastes; and as the sale of natural port, properly preservable, has become feasible, its success will also be certain. We shall take care that it does not fail from want of information about it.

Mr. Crawfurd imagines that the wines of the Médoc bear exportation, because there is brandy added to them. He quotes in support the treatise of Le Bœuf. We know it for certain that a little brandy is added to common, very common, Bordeaux wines. We know also that the better Médoc wines are mixed with some Hermitage to give them a little more alcoholic strength. We know as certainly that of the thousands of barriques of good and best clarets, of good years, not one receives a particle of brandy; but even if it did, its alcoholic strength would be nothing like that of Oporto wines. We require no treatises and no assertions: we base ourselves upon analysis. The hundreds, nay thousands, of specimens of clarets that have been analysed by other chemists, as well as ourselves, never contained more than from 9 to 12 per cent. of alcohol, or from 18 to 20, at the utmost 24 per cent. of proof spirit. On the other hand, no port we ever examined had less than 36 per cent. of proof spirit, and the average strength is 39 to 40 per cent.

Mr. Crawfurd states that there were in January 1867 upwards of 100,000 pipes of wine in stock in Oporto, of which the average strength, according to some examinations instituted by an inquirer deputed by the Portuguese Government, was 40 per cent. of proof spirit. Mr. Crawfurd admits, on the other hand, that a few richer wines might contain 41, 42, and even 43 per cent. To all these wines, however, 1 per cent. of proof spirit is added on shipment. We then get what our analyses exhibit.

THE ELDER-TREE ON THE DOURO.

The use of the elderberry is mentioned by Croft as having been commonly resorted to so long ago as 1727.

During the years from 1754 to 1756, there was great depression in the port wine trade at Oporto, and to revive the trade a company with a monopoly was established under the Marquis of Pombal. One of the pretexts for the establishment of this injurious institution was that the export of port wine had diminished in consequence of adulterations, and that one of the duties of the new company should be to preserve the pure character of port wines. A law was then made which subjected any man to transportation for life, in case he should be convicted of making use of elderberries or of practising adulterations or admixtures to wines of any kind. The possession by the farmer of any elder-tree on any part of his land was made a felony, for which his goods were to be confiscated, and he was to be transported for life. This dreadful law was made valid for the whole of the wine district, and a circle extending five leagues beyond the boundary-line. It remained valid up to 1833; that is, for seventy-seven years, and fell with the old company. But ever since 1820 adulteration had begun to be openly practised, and when all restrictions were removed the elder-tree became an object of general cultivation, and has remained so ever since. When the new company was established in 1843, it issued an exhortation to the farmers not to make use of elderberries, but no penal law was enacted against their use.

Consul Crawfurd now reports that the local demand having ceased, the elder trees are being destroyed, and that he had himself seen a row of them cut down, almost the only ones he observed in the wine district. But curiously enough a demand for elderberries has sprung up from abroad, principally from Spain, and the dried elderberry is largely exported thither and to ports of France, as shown by a statistical table published by the Customs' authorities of Oporto.

Exportation of dried elderberries (*bága*) in 1866 :—

Brazil	18,162	kilos.
Spain	145,335	"
France	19,000	"
England	1,020	"
New York	1,700	"
Total	185,217	"

Thus the reader may well ask after the district of the growth of these 350,000 lbs. of dried elderberries, if almost the only ones observed by Consul Crawfurd in the wine district were cut down before his eyes!

The elderberries give a taste and smell to the wine which is quite unmistakeable, and a dark purple colour, which is very different from the lighter pink or peculiar colour of true port wine. It is stated that only about 1 per cent. of the port wine now made is stained with elderberry, and that wine of very inferior quality. Now even 1 per cent. would give a thousand pipes of stained wine. But can we believe this limitation? We may inquire by the guide of spectrum analysis. While, as we have seen above, genuine port wine gives a spectrum showing a broad absorption band in yellow, and a continued absorption of the blue and violet, the juice of elderberries gives a spectrum showing a narrow absorption band in red, and two absorption bands in blue, thus:—

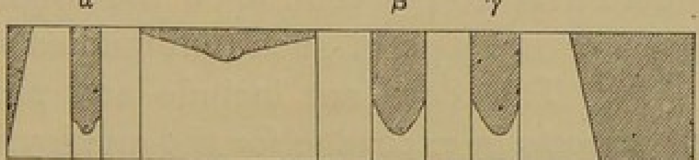


FIG. 85.—Diagram of spectrum of elderberry juice.

Every port wine or other wine yielding this spectrum, has been dyed with elderberry. The consumer, merchant, and shipper have therefore in the spectroscope the ready means of diagnosing the admixture of elderberry juice.

HISTORICAL NOTES OF THE PORT WINE TRADE.

The first pipe of port is reported to have been shipped in the year 1678. During the ten years following this event 600 pipes were shipped each year. In seventy years the annual exportation rose to 17,000 pipes. In 1757, the monopoly of the wine company was established, and continued to the year 1833, when it was abolished. During these seventy-seven years, the annual exportation amounted to 33,300 pipes. After the company was abolished, the annual exports fell off by 2,000 pipes, and this continuing during nine years, a new company was established in 1843. The exports thereupon rose again to 33,333 pipes per annum, and increased little until this company too was abolished in 1867.

Of this number of pipes exported, about 28,000 came to Great Britain annually, during the free times from 1838 to 1843; but after the revival of the monopolized company only about 21,000 pipes were allowed to come to England annually, although the production of port wine during the years 1846, 1847, 1848, had risen to 107,000 pipes a year.

VALUE OF PORT WINE.

A pipe of port wine in the hands of the farmer in its natural state (about 1852) varied from £5 to £17. To bring this wine to the river would add £3 in expenses. To ship it to Oporto would add another £3. The wine would then have to be kept for at least two years. There are therefore loss: by leakage and evaporation; interest of money two years; expenses of storing; expenses of business and labour, together estimated at 20 per cent. upon the original outlay: so that the cost of the pipe of such (unbrandied) port would be at least £27. This does not include any profits, which the merchant expects in exchange for the employment of his talent and capital.

The cost of the lowest port ready for shipping (about 1852) was from £11 to £12.

WHITE PORT.

White port is now no longer exported from Portugal. It is, or was, a delicious fine-flavoured and very spirituous wine, but had less bouquet than the white wines of other countries.

POSSIBLE EXTENSION OF PRODUCTION OF PORT WINES.

Much fresh land could easily be brought under cultivation; and certainly much that is already cultivated could be improved into producing more wine, under the influence of a regular and increasing demand. It has been stated that the proportion of good, of abundant, and of average vintages is, when compared to bad and deficient ones, larger in the Douro district than in other producing countries. The following table furnishes the data concerning the Douro, which may serve as one side of the comparison. It was collected by Mr. Crawfurd, partly as the result of conversation with the wine-shippers of Oporto, partly from the books of a gentleman who is a wine-grower himself, and also a continual purchaser and shipper of the wines of other farmers.

Year and quality of the Wine made in the Douro district.

1840—very fine.
1841—very bad.
1842—fine.
1843—middling.
1844—fine.
1845—inferior.
1846—good.
1847—very fine; rich.
1848—good; not so rich.
1849—middling.
1850—fine; very good.
1851—very fine.
1852—good.
1853—very good.
1854—fine.
1855—bad.
1856—very bad.
1857—bad.
1858—very good; rich.
1859—middling; watery.
1860—very good; dry.
1861—fine; rich.
1862—good; dry.
1863—very fine and rich.
1864—middling sweet and rather poor.
1865—good, not liked at first, but turned out well; rich.
1866—cold and rainy season; much wine obtained; sound, but common.

Out of 25 vintages 16 are good, four are of average quality, and five only are bad.

ALPHABETICAL LIST OF THE PRINCIPAL PLACES IN THE WINE DISTRICTS OF THE ALTO DOURO.

Abassas.
Adorigo.
Alijó.
Alvaçoens do Córgo.
Alvaçoens do Tanha.
Barcos.
Barqueiros.
Barrô.
Bertêllo.
Cambres.
Canellas.
Castanheiro.
Castêdo.
Cazaes.
Cazal de Loivos.
Celeirós.
Chancelleiros.
Cheires.
Cidadeltre.
Comieira.
Constantin.
Cóttas.
Cóvas.
Covelinhas.
Donêllo.
Ermida.
Ervedóza.
Estráda.
Faváios.
Folgóza.
Folhadella.
Fontellas.
Fontêllo.
Fontes.
Fornellos.
Galafúra.
Godim.
Goivaens.
Goivinhas.
Guiaens.
Larnégo.
Loureiro.
Mofomedes.
Mogalhãa.
Medroens.
Mezãofrio.
Moura Morta.
Nagozello.
Oliveira.
Parada do Bispo.
Paradella.
Penajoia.
Persequeda.
Pezinho.
Pêzo da Regôa.
Pinhão.
Poiares.
Povoação.
Provezende.
Quinta da Roncão.
Ribalonga.
Roriz.
Sabróza.
Samfins.
Samodaens.
Sande.
Sanhoanne.
S. Adrião.
S. Christovão.
S. João da Pesqueira.
Sta. Martha.
S. Martinho d'Anta.
S. Miguel.
Serra do Marão.
Soutello.
Taboaço.
Travasos.
Tua.
Val de Mendiz.
Valdigem.
Valença.
Vezuvio.
Villa de Cottas.
Villa de Maçada.
Villa de S. Romão.
Villa Juzãa.
Villa Maior.
Villa Marim.
Villa Real.
Villa Secca d'Armamar.

OTHER WINES OF PORTUGAL.

Lisbon.—Dry. } Both white.
„ Sweet. }

Palmella. } Wines grown in the neighbourhood of Lisbon,
Inglezhinos. } not exported under their own names.

The principal repositories are at Sacavem, a little town, eleven miles up the Tagus.

Bucellas.—This is said to have originally been made from transplanted Rhenish vines (variety unknown), and to have had the flavour and properties of Rhenish wine.

Carcavellos.—White wine (syn. Calcavella).
Arinto.—White.
Termo.—White.
Lavradio,
Lamego,
Torres Vedras, } Red wines.
Monçaon,
Colares,

Setuval.—Two varieties: one sweet Muscat, the other dry; both white.

A low-priced, natural, dry, red wine, termed *consumo*, meaning a wine for ordinary use, grown in the Douro valley, but not in the Alto Douro or Corgo district, is now offered for sale in London. Such wine has never yet been imported into this country because, as was alleged, it could not bear the transport. The *consumo* alluded to, however, is in a perfectly sound condition, and not likely to be affected by any transport on land or sea—an effect, no doubt, due to the peculiarly skilful mode of treatment to which it has been subjected. It yielded to chemical analysis the following results:—Specific gravity of wine = 992·4; ditto of de-alcoholized wine = 1009·5. Distillate directly 982·5 = 11·23 per cent. alcohol; distillate calculated 982·9 = 10·91 per cent. alcohol. Fixed acid in 20 c. c. = 13·0 c. c. $\frac{1}{10}$ normal soda; total free acid in ditto = 15·2 c. c. ditto. On spectrum analysis the wine showed the same phenomena as the Alto Douro; but they were much less intense. The ammoniacal solution of the wine differed from that of the Alto Douro above described by passing more red and less green, and showing the absorption band less distinct. In its alcoholicity this wine stands above the light Bordeaux wines, which have from 8 to 9 per cent. of alcohol; above the wines of the valley of the Rhône, which, like Beaujolais and Hermitage, have from 8·6 to 10·5 per cent.; and keeps close to, but slightly above, the full qualities of Burgundy, which show from 9·3 to 11·39 per cent. of alcohol. The *consumo* is of the vintage of 1869, yet ready for drinking, and is quite peculiar and of port-wine flavour. It is sold to the public at a price which is fully one-third less than the ordinary prices of similar Gironde, Côte d'Or, or Rhône wines. Its dietetic qualities are of a high order. Its higher alcoholicity adapts it well to the wants of our moist climate. It is perfectly pure, quite dry, and as free from adventitious alcohol as the fullest Burgundies. It is therefore good to drink with meals, and acts as a powerful tonic. Let us hope that the Peninsula may be able to send us a great deal of such agreeable beverage!

CHAPTER XXII.

THE WINES OF THE ATLANTIC ISLANDS.

FIRST GROUP: MADEIRA AND THE SMALL DESERTAS: Historical note.—Soil.—Varieties of vines.—Mode of cultivation.—Vintage and vinification.—Maturation of the vine; vino de roda.—Description of the wines.—Quantity of wine produced.—Destruction of vines by the oïdium. SECOND GROUP: THE CANARIES, comprising Teneriffa, Canaria, Lanzerote, Fuerteventura, Palma, Gomera, and Ferro.—Vines.—Situation.—Wines, Malvasia and Canary-sect, vino seco, or seccato.—Production.—Oïdium. THIRD GROUP: THE AZORES comprising Pico, Terceira, San Miguel, Fayal, San Jorge, and Graciosa.

FIRST GROUP.—MADEIRA AND THE SMALL DESERTAS.

Historical Note.—Madeira was discovered by the Portuguese under Prince Henry in the year 1418. They destroyed the forest round the southern bay, now called "of Funchal," and in 1421 planted vines, alleged to have been brought from Cyprus and Candia. The burning of the forest on the southern side of the island occupied the settlers about seven years, and their plantations had an immediate and great success.

Soil.—Madeira consists of a basis of tertiary chalk, which is overlaid by the eruptive products of a now dead volcano, the Pic Ruivo, 6,000 feet high. These various products are basalt, trachyte, tufa, and different later lavas; they form steep slopes, with many ravines, and here and there considerable landslips make the territory very intricate for access and cultivation. The volcanic rock disintegrates under the influence of rain and sun, and becomes a soft stone (*pedra molla*), which is now easily transformed into a gritty soil, in which all kinds of plants grow readily. This soil has to be retained everywhere by terraced walls, as otherwise the rain-water would carry it quickly down the valleys into the sea.

Varieties of Vines.—The Malvasia, said to come from Candia, is supposed to yield the best Madeira wine so-called. The Vidogna is perhaps cultivated on a larger area than the Malvasia: it is similar in appearance to the Chasselas, and yields dry Madeira. Subsidiary vines are the Bagoual, the Sercial or Escanagao, the Muscatel and Alicante. These bear white grapes, but the following produce all black grapes—the Batardo, the Tinta, or Negramol, and the Ferral. In the last century, a vine with black grapes was much cultivated, which was called the Pergola. With the exception of the Tinta, most black grapes are used for making white wine.

Mode of Cultivation.—The vines are fastened to espaliers of wood and reeds, which vary in height between 3 and 6 feet. Sometimes the canes are trained in arches, so that the grapes ripen in the shade of covered walks. On the northern part of the islands the vines are trained upon pollards, and the grapes in consequence are watery and without quality. During the rainy season, from October to March, the vines are leafless, and the vineyards look then bare and desolate. In the middle of March the vines begin to sprout, and early in April they are quite green; they blossom in May and June, and perfume all parts of the island. At this time cold nights sometimes damage the blossoms, and cause a deficiency in the future crops. But the heat of summer in any case quickly develops and ripens the grapes, so that the harvest can begin at the end of July.

Vintage and Vinification.—The grapes are trodden, and the mash is pressed in crude lever or tree presses. The must is fermented in barrels. When sold to the wine-merchant, it is transported to their cellars in small barrels or bags of goat-skins slung to the backs of mules. From this sale of the wine *in mosto* has to be distinguished the later sale of the made wine in a clear state, which is called *in limpo*. The must is mostly mixed with brandy at once, stated to be from half a gallon to a gallon to the Portuguese pipe. After the first fermentation is over, the wine is racked from the gross lees, and again mixed with a similar quantity of brandy. After about three weeks, it is racked a second time, fined, and a gallon of brandy is again added. When the wine has become bright, it is racked for the last time, and placed in large barrels for ripening. This process requires about six years. Before exportation each pipe receives another gallon of spirit.

Maturation of the Wine.—The maturation of the wine can be effected by time alone, but it succeeds quicker and better by the aid of heat and motion. To that end the wine is placed in ships as merchandise, and sent on a shorter or longer voyage to the West or East Indies, to Java or China. After its return it has become travelled wine, or "vino de roda." It is probable that the heat and motion to which the wine is subjected effect a quicker oxydation of the extractive and astringent principles, and an earlier formation of the ethers to which the wine owes its flavour. The wines which are not shipped are placed into magazines, which can be heated, and left there for some weeks or months. This process also effects a quicker oxydation, and in addition destroys any fungi which are capable of making the wine scuddy, or of otherwise changing it unfavourably. For Madeira, like all other southern wines, is subject to many accidents, such as scud, ropiness, bitterness, acetification; and much wine, which is sent out in an unfit state, returns more or less spoiled. Against these mishaps brandying has hitherto been the only remedy, but the wine-makers have at least had the good taste of confining the addition of spirit to the minimum compatible with safety.

Description of the Wines.—The Madeira wine, ordinarily so called, is a more or less amber-coloured liquid, of a peculiar agreeable flavour. In it lives the genius of the Malvasia and Vidogna grapes. The Sercial also gives it particular qualities, namely, astringency, and with this, lasting qualities; but the roughness produced thereby somewhat retards its maturation. Most Madeira is dry; that is to say, free from sugar, and is therefore capable of being preserved with less brandy than sweet wines. The best qualities improve during ten years in barrel, and then during ten years in bottle, and after that become less perfect. The red varieties of wine made at Madeira are neither distinguished as to quality, nor large in quantity. They resemble the lighter wines of Portugal, the Consumos, in character.

Classification of Growths.—The best vineyards on the south side belong to the Royal Family of Portugal, and their products do not get into trade. The best district yielding saleable wines is the Pago de Pereira. Vineyards of the second class are Calheta, Arco da Calheta, Porto da Sol, Ribeira Brava, Cama de Lobos, Estreto, Santo Martinho, and Santo Antonio. The wines on the northern side of the island are mainly used for distilling brandy. The most notable vineyards in this part are those of Porto da Cruz, Santo Jorge, Ponta del Gada, Portomoniz, Santo Vincente, and Seycal da Norte.

Quantity of Wine produced.—Before 1852 Madeira produced annually about 20,000 pipes of wine, and in abundant years sometimes 30,000; but in the spring of 1852, shortly after blossom time, the oïdium invaded the vineyards, and in a few weeks destroyed the entire harvest. With the exception of 1856, in which year about 200 pipes of wine were made in the north of the island at Ponta del Gada, and Arco de Santo Jorge, where the vine is carefully trained on low espaliers near the soil and not reared on pollards, no wine was made in the island during five years ending 1857. This engendered an annual loss to the proprietors and cultivators of upwards of £230,000 sterling. The proprietors tore out the vines, and planted sugar-cane and yellow squash; the espaliers once loaded with grapes now became yellow with pumpkins. Since 1860 the vine is again more cultivated at Madeira; but the exportation of wine has not yet, in 1871, risen to one-tenth of what it was in 1850.

The territorial law of Madeira is one of great complication, which makes the sale and purchase of land almost impossible. In consequence, capital has few chances of employment, and it is possible, while much to be regretted, that Madeira may never recover its viticultural value, but sink to the low position of the Turkish islands of the Mediterranean.

SECOND GROUP.—THE CANARIES.

These islands comprise Teneriffa, Canaria, Lanzerote, Fuerteventura, Palma, Gomera, and Ferro. All have volcanic soil, and produce wine from the Malvasia and Vidogna grapes. The best situations at Teneriffe are near the capital, Laguna, and further at Orotava, Tacaronte, Matanza, Val d'Icod, Dante, Silos, Guimar, Tagamana, and Teguina. The Vidogna wines are dry, and similar though inferior to Madeira; in particular, they have less perfume, though they are brandied to the same extent as the Madeira,—a proof that flavour is not the result of the addition of spirit. The Malvasia is a sweet liqueur-wine, similar to that of Madeira, and, like this, tastes of pine-apple, a perfume probably derived from that fruit. Canary-sect of former times was the sweet white wine of these islands, "vino secco," or "seccato," so called because it was made from grapes which had been dried or passulated to a certain extent before vinification.

Next to the named vineyards of Teneriffe, the vineyard of Herminga upon the island of Gomero, and that of Jolfo upon Ferro, and the vineyard of Palma, have the greatest reputation. These islands formerly produced 25,000 pipes of wine; but this has been reduced to one-tenth by the oïdium. Before 1852, most Canary wine was sold as Madeira, which had the greater reputation. In the present day it is transmuted into "sherry" by being vatted with small quantities of the product of the Palomino grape.

THIRD GROUP.—THE AZORES.

These islands, situated to the north-west of Madeira, formerly produced much wine; the island of Pico alone about 5,000 pipes annually. The sweet Malvasia was called Vino passado; the Vidogna, Vino seco. The islands of Terceira, San Miguel, Fayal, San Jorge, and Graciosa, all yielded valuable wines, which were exported from Angia and Fayal to North America and Brazil. These also were almost destroyed by the oïdium.

CHAPTER XXIII.

THE WINES OF ITALY, ROUMANIA, GREECE, AND THE TURKISH ISLANDS.

WINES OF ITALY: Wines of Piedmont.—Wines of Sardinia.—Wines of Tuscany.—Wines of Lombardy and Venetia.—Wines of Central Italy.—Neapolitan wines.—Wines of Sicily. WINES OF MACEDONIA AND THESSALY (Roumania). WINES OF GREECE: General remarks.—Vines.—Vinification.—South Thessaly.—Livadia.—Morea.—Islands of the Archipelago.—Santorin, ancient Thera.—Mode of training the vine.—Varieties of vines.—Quantity of wine produced.—Qualities of the wines.—Ionian Islands. WINES OF THE TURKISH ISLANDS: Candia, ancient Crete.—Rhodes.—Cyprus.—Cipro vine.—Classes of wines.—Wine of the Commandery.—Capacity of Cyprus wine-measure.

WINES OF PIEDMONT.

IN this part of Italy a great variety of wines is produced. Those of Asti and Chaumont have acquired a reputation. Alba and Montferrat also produce red and white wines. We have obtained a number of wines from Turin, but found them inferior and dear. The *spumante*, or effervescent wine, mostly grew regular furs of fungi in the bottles. The red were all in a state of fermentation, or frisky (Italian *fresco*), and turbid. Some retained the peculiar biting taste after complete clearance. A number of red wines which have come under our observation were made from the Grignoli grape, and named grignolinos. The better qualities had great merit, and we think that if this vine were cultivated with attention, and its product reared with scientific precision, a most valuable wine might be the result. The Grignoli vine[1] is closely related to the Carmenet of the Gironde on the one side, and to the Kadarka of Hungary on the other.

WINES OF SARDINIA.

So-called Malvasia wines are produced at Sorso, Posa, Alghiere, and Naxo. The Malvasias of Caunonas, Monai, and Garnaccia are exported. The wine of Giro is like the tinto of Alicante. Other red wines are those of Bosa, Sassari, and Ogliastra.

WINES OF TUSCANY.

In this duchy the best Italian wines are produced, partly because the climate is most favourable, partly because the former Government and many nobles paid great attention to the improvement of the vineyards, and imported suitable varieties of vines from other countries. Nevertheless, vinification, although the best in Italy, leaves much to be desired.

Of vines, the aleatico, or red muscat, is most extensively grown, at Monte Pulciano, between Sienna and Rome; at Monte Catini, in the Val de Rievole, and at Ponte a Moriano. The wine is purple in colour, sweet, and slightly astringent in taste. A good red wine is made at Chianti, near Sienna, from a peculiar grape. The wines of Artimino, a former grand ducal estate, and of Carmignano, are also of good quality.

At Arcetri, near Florence, was prepared the best Verdea, or green wine, so called from its colour, and much esteemed by Frederick the Great of Prussia. Another celebrated wine is the Trebbiano, a gold-coloured syrup, produced from grapes passulated on the vine by torsion of the stalk. The vine is named Trebbino.

The nobles of Florence, like those of Vienna, sell their wines by retail from their palace cellars, in *fiascos*, or flasks, of the shape of the well-known oil flasks, containing about

[1] The vines of Italy were described by Joseph Acerbi, in 1825. Those of Sicily were first described by F. F. Cupani, in 1696. He distinguished forty-eight varieties. Neither of these works has been accessible to us.

three quarts each. These bottles are not stoppered, but the wine is covered with a small quantity of oil, which is either flung out, or soaked out with tow previous to using the wine.

WINES OF LOMBARDY AND VENETIA.

In Lombardy and Venetia the vines are grown on the margins of the cultivated pieces of land, or in rows intersecting them. Trees are planted for the purpose of supporting the vines. Such trees are sometimes called "pollards" in English. They are trained and cut to that particular shape which will best serve the purpose. The variety of tree which is taken is mostly a kind of maple. Vine and tree are planted together. The stem of the vine is of the same length as that of the tree, and the branches of the tree, stripped of the greatest part of their foliage, form the support of the head of the vine. At that height above the ground very nice grapes grow, but even in the climate of Italy they never attain that perfection which is necessary to produce good wines. The vine is cut as follows:—The branches which have been growing all over the maple are collected, twisted into a rope, and then tied together with a similar rope produced from the next tree. In this way all the bearing wood forms garlands reaching from tree to tree. As the ropes of the year before have been cut off, there are, of course, left on the vine a number of spurs which, now in spring, grow the canes for the next year. This mode of cultivation has so many advantages connected with the ordinary method of agriculture in Venetia that we do not think it likely that it ever will be changed. The trees give the little fire-wood required for cooking; and the vine can be produced at a low cost, owing to the circumstance that it occupied no space on the ground. The garlands at the heads of the trees do not only look picturesque and give to the whole country a kind of festive appearance, but they also afford protection from the wind, and from the glowing sun, during the hot part of the year, to crops, men, and animals. Here also the system of small farms and payment of rent by natural produce, prevails. The rent consists mainly in wine for the proprietors, in the cuttings of the mulberry-trees, and in a quantity of grapes. The vintage is mostly effected by the proprietor himself. In this way all calculations of wages, of rent, and so forth are avoided. During the last fifteen years, however, Venetia has suffered very much from the oïdium. We have seen the accounts of a property, the marginal rows of which yielded during ten years, from 1843 to 1852, £2,000 worth of wine; but during the years from 1853 to 1862, the yield was only a little more than £200.

The cutting of the vines is here effected not in the same careful manner as in France and Germany, but the immense power of vegetation admits of a much cruder process. The workmen cut the old branches with an old sword blade, or a heavy sickle, and there is no more ceremony made with the vine than if it were a shrub of the hedgerow. A field covered with vines looks from the distance like a common forest. The grapes are vintaged at a time when they have the greatest volume. The mash is allowed to stand from six to eight days. The hat is frequently submerged. The wine is then drawn off, but the murk is not pressed, for the farmers of these little properties have the right of making their piccolo from the unpressed murk. The wine which one can get to drink in the plain of Venetia is always very poor. It is not dark red, owing to the imperfect ripening of the grapes in the air. It has a very astringent taste, caused by the long contact of the stalks with the must. It contains very little sugar, little alcohol, much acid, and not any aromatic properties. It is an exceedingly cheap drink to quench the thirst in summer or winter. From the Venetian plain the cultivation of the vine extends into many of the valleys of the Alps which open into it, particularly that of Udine, the valley of the Tagliamento, up to Tolmezzo, and the Piave. At the valley of the Adige, however, the peculiarity ends. South Tyrol commences, and with it new and German methods of cultivation. In many of these valleys viticulture might attain the highest perfection if it were directed to quality, and if selected vines were grown in closed vineyards with that care and attention which are bestowed upon this branch of production on the Rhine and in France. Here wines might be produced which would be unsurpassed by any other wines in the world. Here there is an equable temperature, and a sufficiency of those precipitations of moisture during nights of calm radiation from the nearest hills. Here is rain at the proper time, and plenty of the direct rays of the sun come in the month of August, when the vine is most in need of it. Indeed, here are all the conditions for producing not only a sweet wine, such as is common in climates which only have sun and heat, but for the production of those flavoured wines which are the privilege of those parts of the world where the so-called great wines are grown. But the indolence which affects the mass of the Italian nation, and is perhaps the product of the ease with which they are enabled to carry on life, also affects viticulture here as throughout Italy, and proves the truth of the sorrowful words of Matteucci, "*Este in Italia ni studio ni lavore.*"

WINES OF CENTRAL ITALY.

The former Papal States produce the wines of Orvieto, and the muscats of Albano and Montefiascone.

NEAPOLITAN WINES.

Lachrymæ Christi is produced from vines grown at the base of Mount Vesuvius, and is reputed to be the strongest of the wines grown in the Naples district. A sample of 1860 vintage was obtained from the grower in its natural state, and found to contain 18·9 per cent. of proof spirit.

The province of Puglia or Terra d'Otranto produces the wines of Gallipoli and Taranto. 1860 Gallipoli, obtained by the Board of Customs at Naples, had, as a precautionary measure—not from necessity, as it was alleged by the gentlemen who furnished them—been mixed with 4 per cent. of spirit, believed to be of the ordinary strength of Cognac. This wine contained 26·5 per cent. of proof spirit.

Taranto, 1860, containing 23·9 per cent. proof spirit, came, like the Gallipoli, from a gentleman at Naples, who had the wine direct from the grower.

WINES OF SICILY.

Of Sicilian wines only one variety is exported in large quantities,—namely, the white or light amber or brown wine, which goes under the name of the exporting town of Marsala. In the neighbourhood of Messina there is grown the Faro wine, reputed to be the strongest wine of North-eastern Sicily. Near Mount Etna is made the wine of Terre Forte, in the vineyards of the Benedictine monks. The latter varieties, if they occur in trade at all, do not do so under their own names.

Marsala is situated near the western termination of the northern coast of Sicily. Its vineyards extend along the coast towards the east and west in a band of upwards of twenty miles in length and twelve broad. The soil is a mixture of chalk and clay, coloured yellow or reddish brown by oxyde of iron; in other parts there is sand or gravel, mixed with loam.

Of the varieties of vines cultivated at Marsala we have not been able to obtain certain information. To conclude from the nature of the wine, the varieties must be many, and all of inferior quality.

All the wine shipped from Marsala to England is strongly brandied. Much of it is sold as such, but large quantities are transformed into imitation sherry. We give on pp. 293–298 the analyses of samples of wine from Marsala.

Red wines are also grown in the island, and owing to their low price are exported to other parts of Italy and to America. Faro wine, vintage 1860, was obtained from the grower by the London Board of Customs, and on analysis was found to contain 22·7 per cent. proof spirit; the assertion that it had been in its natural state, and that no spirit of any kind had been added to it, is therefore borne out. The wine of Terre Forte, grown by the Benedictine monks of Mount Etna, is reputed to be the strongest wine grown in the eastern district of Sicily. The sample of wine of the vintage 1859, which was obtained by and examined for the Board of Customs, contained 29·9 per cent. proof spirit.[1]

The total quantity of wine produced in Sicily is estimated at 200,000 pipes, which seems a great exaggeration. Only one-fifth part of the quantity produced is believed to be fit for exportation. The Marsala pipe contains 93 gallons.

The consumption of marsala in England has but slightly increased since the reduction of the duty; namely, by about one-fifth of what it was at the time of the reduction. There are less than 300,000 gallons consumed in England.

WINES OF MACEDONIA AND THESSALY (ROUMANIA).

They are middling wines, mostly of intolerable taste, on account of the tar (or pitch) which is added to keep them; but on the Hagion Oros on Mount Athos, German monks have introduced their improved methods of vinification. Commercial wines are produced in Macedonia: at Chatista, Florina, Kiprio, Castoria, in the district surrounding the Lake of Ochrida, in the plain of Serres; at Piliori, Crotova, and in the valley of Resne; in Thessaly; at Larissa, Cachia, and Arta. In the village of Galistas, on the slopes of the Bernos, much simmered wine is made, of which Mahommedans partake. Albania produces much wine of red and white colour, which keeps without pitch.

WINES OF GREECE.

General Remarks.—The kingdom of Greece is a mountainous country; its ranges are schistous, chalky and volcanic, and offer many declivities, sloping towards the south, most favourable to viticulture. It has a warm climate tempered everywhere by the neighbourhood of the sea, and its sky is always clear and beautiful. But its cultivation has for centuries been much neglected; the crops which were raised were mostly sold to foreign countries, and thus the soil became irremediably exhausted. The rains washed the soil down

[1] Report on Strength of Wine. Parliamentary Return, April 29, 1862, p. 26.

into the rivers and sea, and the land became denuded and sterile. There was little labour, less live stock and manure; brigandage kept the population in terror and uncertainty. In consequence of these deplorable conditions the production of wine in Greece, which was considerable at the time of the Venetian supremacy, has sunk to a relatively insignificant amount. But the production of currants is still a highly important branch of Greek agriculture.

Vines.—The principal vine cultivated in Greece is the Vitis Corinthiaca, also called Apyrena, the stoneless, and from its product, Uva passa. It is mostly grown as a shrub without support, with a strong stem from which spring short branches. The one year's wood is brown, with dark brown points, flat at the insertion of the eyes. The leaves are large, thick, leathery, and, in many details of their lobes and serrate margins, rather peculiar. The bunches are long, loose, and pendulous, with small unequal berries. The berry-stalks are very long and thin. The berries are the smallest of all grapes, have a thin husk, and contain no stones. There are a number of varieties of this plant, best recognized by the varying colour of the grapes. The commonest is yellowish green, with a strong grey bloom; another is violet; and a third blue. These vines are also much cultivated in Asia Minor and in Italy. The raisins termed currants are produced by twisting the stalk of the ripe bunch, and thus interrupting the passage of juice into the grapes. They then dry up and are collected, separated from the stalks, and packed for exportation.

Another Greek vine is the Greco, of which we possess no particular description. A third is the Cipro, the vine peculiar to Cyprus. Its wood is yellowish brown. Its leaves are very thin, mostly trilobed, with large teeth round the margin. The bunch is large, long, and has mostly short branches. Most peculiar are the berries: they are large, and, while unripe, are thick at the insertion of the stalk, and pointed towards the umbilicus, but when ripe they have the shape of acorns, and are dark blue with few points. The white and black Moscada of Greece are identical with those of Frontignan. The Malvasia exists in several varieties, which are not as yet well diagnosed.

The Sultana is cultivated for its stoneless large raisins, but not on so large a scale as in Asia. The most important vine for the small islands seems to be the Assyrticon, which forms the great majority of the vines of Santorin, and is cultivated in a peculiar manner, to be described below. Besides these, there are cultivated in Greece about sixty varieties of vines, of which we have not been able to ascertain either the names or descriptions.

Vinification.—This is mostly very imperfect, so that the wines contain more volatile, *i.e.* acetic acid, than any others which we have met with. Many wines last only through the winter, and in summer turn into vinegar. To avoid this result the proprietors still adopt all the horrid preservatives of antiquity: smoking with wood smoke, or vapour of rosins, such as mastic, olibanum, cloves, Rhodus wood, Buchari-Iagh, and labdanum,—the Commendaria (Cyprus) wine is said to get its flavour from these rosins and gums and spices, which are suspended in the wine, enclosed in a bag; pitching the barrels, adding turpentine and real pines; addition of gypsum, chalk, salt, and of tannin, particularly in the form of hypericum perforatum, a resino-tannous plant, which is said to conserve and colour wine yellow. Most wine has also the taste and smell of the goats, in the hides of which it is kept or transported. In Cyprus and other parts jars are still in use, but in Santorin and other islands barrels are becoming more frequent. The several parts of Greece produce, according to the "Journal des Travaux de la Société française de Statistique universelle," the following kinds and quantities of wine:—

Southern Part of Thessaly, situated between Turkey, the sea of the Archipelago, Livadia, and the Ionian Sea, under 38° N. latitude. The south-eastern part is called Akarnania, and produces wine at Arta, Limni, and Komboti.

Livadia, ancient Greece proper, between Thessaly, the Archipelago, and the Gulf of Lepanto. The principal vineyards are near Lepanto, Chæronea, Megara, and on the slopes of Mount Poligouna; secondary vineyards are near Koskina, and in one of the valleys of Mount Helikon. Not far from Athens is Mount Hymettus, known by its bees and honey. The wine bearing its name is grown in the plain surrounding the mount. Near Megara, twenty-seven miles west of Athens, upon the frontiers of Livadia and Morea, is the port of Cendura, from which much wine and large quantities of currants are exported. Upon the isthmus is situated what remains of Korinth, the ancient town known by games and currants, often destroyed by earthquakes.

Morea is a peninsula, situated under 36° and 37° north latitude. Its northern part, Achaia, has extensive vineyards near Patras, Blattero, Voltizza, and Kalavrito. Near the latter town is the convent of Megaspileon, where the monks make and keep wines in large quantities, some of their tonnels holding from 7,000 to 15,000 litres. In the county of Elis, or the circle of Gastonin, much red and white wine is made. The best wine of the Morea is made near Pergos, and amounts to 100,000 barils annually. Red and white astringent wines are produced near Barbacena and Budschaka, on the left bank of the Alpheus. Schiron, near Palacropolis, produces currants and wine of 280,000 piastres' annual value. Argolis, east of Achaia, has vineyards near Argos, and in the valley of St. Giorgio, twelve miles from Argos. Nauplia, or Napoli di Malvasia, the place whence Malvasia wines derived their name, was nearly destroyed during the Greek wars of independence, and produces but little wine in the present day. Arcadia is in the centre of the Morea, and produces annually 15,000 barils wine, value 150,000 piastres; and 2,000 barils brandy, value 80,000 piastres. The largest vineyards are in the valley of Phokia, eighteen English miles north of Tripolizza. In the district of the latter town, known as Tripolis, 15,000 barils of wine are made. Messenia is the south-western part of the Morea, situated upon the Ionian Sea. The vineyards near Androussa and Nisi produce annually 15,000 barils of wine and 600 barils of brandy, value 177,000 piastres. Modon, a promontory west of Koron, produces 2,000 barils, value 20,000 piastres. The south-east of the Morea, Lakonia, makes much Malvasia, particularly at Misitra. Few of these wines, red or white, rise to the quality of third class; many remain much below.

The Islands of the Archipelago, situated under 36° to 39°

north latitude, producing wines or raisins, are in the order from N. to S.: Scopolo, Sciati, Skyro, Negroponte, Andros, Tine, Zia, Myconi, Thermina, Naxos, Amorgo, and Santorini. Near Skyro (Syra) a red wine, Como, is grown. Scio (formerly Chios) grew more wine in ancient times than now: here red and white grapes are mixed. The "Nectar" of Merta is bitter and astringent. Samos exports grapes, raisins, and wines, amongst the latter a muscat. Zea, or Zia, is ancient Cos. Of Tenedos the only production and trade is wine: it sends annually 100,000 barils to Constantinople, Smyrna, and the Euxine, for Russia: this wine is the general table-wine of the Orient, wherever wine is drunk.

Santorin, ancient Thera, is a volcanic island, an imperfect ring, the crater filled by the sea, in the centre a conical prominence. The seaward slopes of the outer ring furnish the wine lands. Of Santorin, Denman, quoting the Abbé Pègues, Supérieur de la Mission de Santorin, "Histoire et Phénomènes du Volcan et des Isles volcaniques de Santorin," as his authority, says (p. 262), hardly a corner is left untilled; and although its clearance and manipulation involve much labour and expenditure, the proprietors cultivate it up to the margin of the rocks. They plant the vines far apart from each other, often eight feet or more, the distance being governed by the quality, the strength, or the aridity of the ground, in order that each stock may be sufficiently nourished and its roots freely developed. The stems, consequently, are strong, short, and vigorous, and grow four, five, or six shoots, which spread out in the form of a chandelier, crowned with an abundant foliage. In due time these become loaded with large grapes, which amply recompense the vintager for his labour, for his care, and for the space which he devoted to the advantage of the root itself.

Mode of training the Vine.—The young plant is closely pruned for the first three or four seasons; and when it has formed a few branches of sufficient strength, the shoots are cut down to two or three feet in length, twined altogether in a roll, and then laid horizontally in a circle on props to support them in the shape of a kind of crown. Each succeeding year, after dressing the branches which the crown has put forth, and pruning such as are too weak, they entwine and rest them on the circle formed the preceding season, widening successively every new layer, and continuing the operation for a period of fifteen or twenty years, so that a sort of funnel or inverted cone is gradually produced by a succession of these crowns uniformly superposed. The plants so fashioned, when in full verdure, resemble a circular bushy shrub, become well laden with fruit, and produce a much larger quantity than older vines; but the wine derived from the grapes is considered inferior in point of quality.

Varieties of Vines.—More than sixty varieties of vines are naturalized in Santorin, but in the manufacture of wine, both red and white, one sort—the Assyrticon—is almost exclusively employed. Some of the vines yield enormous grapes, the bunches weighing sometimes as much as ten or twelve pounds.

Quantity of Wine produced.—In ordinary seasons 9,000 pipes, in years of abundance 11,000 pipes, are obtained. It is principally exported to Taganrok, at the mouth of the Don, to Odessa, and to Tanais in the Sea of Azoph, and goes to supply the wants of the interior of Russia.

Qualities of the Wines.—They are red and white, and are named after the localities of their growth. The best red growth is called *Santorin*, and is dry and spirituous. *Thera* is a white variety, which bears the ancient name of the island and its lost capital. Another white wine, called in the island "the wine of night," is supplied in two qualities, under the distinctive names of *Calliste* and *St. Elie*, the former being the stouter and richer of the two. Besides these, there is a muscadine wine, named *Vin Santo*, made of two colours, the one a deep purple, and the other a golden amber. Such wine is confined to the dessert, and is ordinarily served in small glasses, even at Santorin. It is made from grapes which have been dried in the sun for eight or ten days.

Ionian Islands.—The red wines of Corfu are light and delicate; production 33,000 barils annually. A liqueur from raisins is also made, called Rosolio. Cephalonia produces upwards of 40,000 barils of red wines of the fifth class; also some white muscats. Zante produces dry and sweet wines, amongst the latter a liqueur wine made from currant grapes, called Jenerodi. Thiaki (Ithaca) produces more than 6,000 barils of currants, and Santa Maura is said to produce more than 50,000 barils annually. All wines made in the Ionian Islands are plastered.

WINES OF THE TURKISH ISLANDS.

Candia (ancient Crete) produced formerly a kind of Malvasia wine, of which the quantity produced annually at the end of the sixteenth century is stated by A. Baccius (Naturalis Vinorum Historia; Romæ, 1696, fol. p. 331) to have amounted to 200,000 barils. The wines produced there at the present time are red and white; some muscats do not bear transport. In a ruined monastery, Arcadi, are fine cellars, now disused. The principal vineyards are near Kanea, Kisamos, Spacchia, and Kandia.

Rhodes produces sweet and luscious wines from vines, some of which bear grapes of the size of plums. Here, as in Malaga, three harvests are possible.

Cyprus.—The vineyards of Cyprus are on the slopes of hills covered with flinty stones and a blackish earth, mixed with veins of ochre. The prevailing vine is the Cipro, already described above; it is mostly cultivated on the soil, without the aid of stakes. The wines produced are of three classes. The first class consists of the wines of the Commandery of the Knights Templars, and is made in the vineyards near Paphos, in the district of Orni. It is fermented and matured in about 40,000 earthenware vessels of the ancient shape of amphoræ, of which each holds from ten to twelve litres. The wine is of a dull red colour, and becomes tawny by age, or of a golden yellow, a little sweet, with an astringent bytaste, fiery, of great and peculiar flavour, and a fine bouquet, reminding of bitter almonds, supposed to be imparted to a certain extent by extraneous spices. The second class wines are sweet muscats, of which the best are made at Arnodos. The third class are the common wines, which are at first pale red, but become nearly colourless in time. Two centuries ago this island exported 365,000 cuses (or guzes) of wine; forty years ago the export had fallen to 65,000 guzes. The wines exported in the present day are shipped mainly from Larnaka, the southern port of Cyprus, to Venice and Livorno. At Venice much Cyprus wine is still drunk. The Cyprus wine measures are the cass, equal to 1¼ English wine-gallon, or 4·73 litres; and the carica, equal to 10·414 litres. The baril, repeatedly mentioned in the foregoing, is the Venetian barilla, equal to 64 boccalis (beakers), or 64·3859 litres, or 14·17112 English imperial gallons.

CHAPTER XXIV.

THE WINES OF ASIA.

WINES OF CAUCASIA: Cachetia, Georgia, Mingrelia, Imeretia, Armenia, and Schirwan. WINES OF PERSIA: King Dschemschid. —Wines of Shiraz.—Description of vines grown at Shiraz.—Production, consumption, and export of Persian wines.

WINES OF CAUCASIA.

THE province of *Cachetia* produces much wine, and, as some relate, nothing but wine. The production amounts to two millions of "Eimer" annually; the price of good red wine is 7*d.* (1 abass) per five bottles (1 tunga). Common wine is sold at from 5 to 6 kopecs, or 2*d.*, per tunga. The natives keep and transport the wine in skins of buffaloes and goats, which are turned with the hair inside and pitched with black naphtha. In some parts the wine is kept in large earthenware vases, of the size of hogsheads, which are buried in the ground. Casks and cellars are beginning to come into use, and the vines are improved by the importation of cuttings from the Crimea.

Georgia also produces much wine, particularly at Tiflis, Signack, Elisabethopol, Mokozange, Vachery, and Tschenie-daly. At Tiflis the vines peculiar to Shiraz are grown, and viticulture is mainly in the hands of vintners from Suabia, or their descendants.

Mingrelia, Imeretia, Armenia, and *Schirwan* also produce wine, and of the parts north of the Caucasus, the valley of the Terek. The best Mingrelian wine is that of *Odischi.* Everywhere German colonists are settled, who produce wine in casks, and realize good prices. It is believed that seven and a half millions of bottles are produced in these parts alone.

The Caucasian wines are mostly colourless, like water; the red ones are pale red. They are fiery, but after three years become bitter, and thereby resemble some of the best growths of Burgundy. Much of the wine in Caucasia is distilled for brandy, of which Cachetia produces 20,000 hogsheads annually. There is also effervescent wine produced in Caucasia, and a Society, the "Caucasian Company for the manufacture of Champagne from Indigenous Grapes," carries on a considerable trade in such wine. It is sold more particularly in Russia, specially at St. Petersburg.

The marine trade of Caucasia, which formerly was so considerable, has been completely destroyed by the Russian blockade, which was kept up for more than a generation for the purpose of subjecting the people of that country. This purpose has now completely succeeded, but the trade of the east of the Euxine has not been restored.

WINÆS OF PERSIA.

It is related by Strabo that, in the district of the coast of the Gulf of Persia called Makine, the vine grew in swamps, and was cultivated in these morasses by people who placed baskets of earth into the water, in which the vines were planted. The vines in these baskets were as detached from the land as a flower-pot in a conservatory, and were now and then carried out of reach of the shore by floods or winds. In that case the cultivators replaced them again by means of long poles to their former positions. This paludal cultivation indicates a similar original occurrence of the plant in the same country.

Persian history and legend contain frequent references to wine. King Dschemschid is celebrated as having raised the accidental discovery of wine to a method of making and keeping it. He was very fond of eating grapes, and caused great vessels full of them to be collected in order to enjoy himself beyond the season. But they fermented and ran to juice, and the mixture boiled so suspiciously, that it was believed to be a new poison, and was put aside for appropriate use. Gulnare, the beautiful, one of Dschemschid's seven hundred wives, grew tired of the tedium in the harem, and determined to destroy herself. She selected the new poison as her agent, and drank a long draught, which became a deep one when she found that the poison, contrary to expectation, tasted very nice. The poison soon acted: Gulnare sank to the ground, and fell asleep. But she awoke to despair. Enraged she doubles the dose. In vain she seeks destruction, but finds happiness in frequent small draughts of the suspected liquid. Shah Dschemschid discovers the effect of the condemned grape-juice upon his mistress, tries, approves, and henceforth is the patron of wine. The wines of Persia most renowned in ancient times were those of Ariana (Iran), Bactriana (Turan), Hyrcania (Mazanderan), and Margiana (Chorassan). Their reputation survived for some time the introduction of the Islam. Mazanderan borders the south of the Caspian, and the fertile part of the Chorassan is the eastern continuation of the former province. All these parts still produce wines, but their characteristics and reputation have become blended in the wine of Shiraz, in the province of Ferdistan on the Gulf of Persia.

WINES OF SHIRAZ.

The best wine-producing district of Persia is situated on the lower ranges of the Zagros mountain, which run from the Gulf of Persia to the Caspi Lake. Shiraz, the capital of Ferdistan, is in the centre of this district, and is surrounded by vineyards and pomegranate orchards. The hills round the neighbouring village of Ferdistan bear the largest grapes of any Persian vine, but the imperial grape of Tauris, though smaller, is considered more juicy and delicate. The best vineyards of Shiraz are situated at the foot of the mountain to the north-west of the town; they have strong soil and an excellent exposure. The vines are mostly grown low, and rarely tied to stakes. In some parts the cultivâtors construct stone walls, and train the vines up one side and down the other, by tying stones to the canes. At Casvin the vine-growers irrigate the vineyards annually, twenty days after the feast of Nokooz, or about April 10, and the Vizier assured Morier, that the clayey soil thus treated retained the moisture throughout the period of vegetation, and the effect lasted until the irrigation in the next year. There are twelve principal varieties of vines.

Kishmish carries a beautiful large bunch of white grapes. The berries are oval, of medium size, have a tender thin husk, no kernels, and are of agreeable acidulous taste. The grapes of this variety serve for eating, wine-making, and the production of raisins.

Damas yields a black grape, from which the finest red wine is made. This wine is full-bodied, rich, and of great durability.

Samarkand.—Of this vine several varieties are grown; some bear bunches up to twelve pounds in weight.

Rischbaba, the principal vine of Shiraz, bears large white grapes without kernels.

Askeri.—A smaller grape than the foregoing; very sweet.

Imperial of Tauris, already alluded to above. Besides these a great number of white, green, yellow, violet, red, brown, blue and black grapes are grown, of which the names and descriptions have not reached us.

The wine of Shiraz is fermented in large egg-shaped vases of earthenware, 4 feet high, and holding 250 to 300 litres, or more than a hogshead. They are glazed inside and outside, covered with purified mutton-tallow, and are kept buried in the earth in cool cellars. The wine is bottled in glass flasks, holding from four to five (old Paris) pints; the bottles are stoppered with hard-pressed cotton, covered with wax, enclosed in matting, and packed in boxes holding ten. It is described by Chardin as being of excellent quality, but not so fine as the French fine wines; indeed its taste is harsh at first, and the stranger must have drunk it for some days in order to fully appreciate all its good qualities. This is the judgment of a Frenchman; the German Kämpfer highly praises the Shiraz wine, and puts it on a level with the best growths of the Champagne and of Burgundy. It is thus evident that the praises which the poet Hafiz bestowed upon the produce of his native town were not altogether fancies. The remarks of the foregoing travellers refer to wine which was as much as possible in its natural state. But there are also fortified or liqueur wines made in Shiraz. A white variety has body, strength, great sweetness, and a peculiar bouquet. The red wine, now and then brought to Europe, is always treated with alcohol and peculiar perfuming resinous matters, which at first suit the European palate as little as the rose-flavoured confectionery of Turkey. But they are no doubt fine and remarkable. The wines of Shiraz are originally sold by weight. The popular proverb considers them as essential agents of happiness: "Who will live merrily should take his wine from Shiraz, his bread from Yesdecast, and a rosy wife from Yest." Next to Shiraz in importance as wine-producing places are *Teheran*, the capital of the Shah, *Yezd, Shamaki, Gilân, Casvin, Tabriz,* and *Ispahan.* All these places are situated on the southern slopes of mountains of greater or less height, and thus offer great facilities for viticulture.

The wines of Persia are mostly consumed within the country, but some are exported to Hindostan, China, and Japan. There is no doubt that both the consumption and production of wine in Persia is much smaller than it was in historic times, and this diminution is due to the influence of the Mahommedan religion: for although the Persians are Sunnites, or adherents of Ali, and therefore much less rigid in religious observances than the Schiites, the followers of Omar, or true Turks, they lean to the observance of the Koran, in which wine is forbidden. Wine and spirit drinking are therefore done in secret, and with the usual results of the Sunday drinking of religious countries. With the open production and sale of wine disappears its knowledge, and it becomes a mystery like Cape port and Elbe sherry. The Persian of to-day buys his wine from the Gueber, Jewish, or Armenian growers, who are licensed upon payment of a tax. It is frequently mixed with raki and saffron, or the extract of hemp, which is added to make smaller quantities more narcotic. However, if the wine drinkers of these countries appear to be behind our present notions of what is devout, by considering that the use of wine legitimately terminates in intoxication, we must be reminded that such ideas prevailed greatly amongst our almost immediate forefathers, and that therefore we may expect the Persians to amend their manners in time as we have amended ours.

CHAPTER XXV.

THE WINES OF AFRICA.

WINES OF THE CAPE OF GOOD HOPE: Topography, climate, and soil.—Historical note concerning viticulture at the Cape.—Varieties of vines cultivated at the Cape.—Peculiarities of cultivation.—Vintage and vinification.—Qualification of Cape wines.—Imports ot Cape wines into England.—Principal viticultural districts and estates: Stellenbosh, Drakenstein, Paarl, the three Constantias. THE VINE IN OTHER PARTS OF AFRICA: Indigenous vines of Madagascar.—French Islands.—Morocco, its vines and raisins.—Algiers. —Egypt.

WINES OF THE CAPE OF GOOD HOPE.

THE following data regarding the wines of the Cape of Good Hope are extracted mainly from a report by Dr. Edward Kretschmar, a German physician who practised at the Cape during more than fifteen years.

TOPOGRAPHY, CLIMATE, AND SOIL.

South Africa resembles in its climate that of Southern Europe, but its soils are deficient in many respects. The predominant soils of the Cape Colony, *e.g.*, are stiff clays, impenetrable to the instruments of agriculture until thoroughly moistened with rain, and light red sands, capable of great fertility, whenever they are sufficiently irrigated. Where, as at Constantia, oxyde of iron and chalk are liberally mixed with the clay and sand, and water can be brought to the soil in the dry season, remarkable fecundity is the result. Grapes, oranges, figs, peaches, apricots, plums grow in great abundance and perfection, particularly in the districts bordering upon the western or Atlantic coast; the eastern coast district is less warm and less fertile, while the interior is to a large extent barren, high table-land, like the interior of Spain.

HISTORICAL NOTE CONCERNING VITICULTURE AT THE CAPE.

Vines were here first planted by Dutch settlers under the governorship of Jan van Riebeck in 1650. They did not elect the most suitable localities for their vineyards, and this want of knowledge of the conditions of successful viticulture operates against the wines of the Cape to the present day. This is the more surprising, as many of the wine-boors are rich and intelligent. Their smallest farms are 120 acres in extent, and freehold.

VARIETIES OF VINES CULTIVATED AT THE CAPE.

Governor Riebeck is related to have imported vines from the Rhine, from France, Spain, Greece, Madeira, and Shiraz in Persia. The muscat of Frontignan prevails in the best situations, and is kept pure. Most expanded are perhaps the cultivation of the German Riessling giving white, and the Burgundy grape giving red wine. Two vines which go under Dutch names, we cannot at present identify any better. They are the Groene-druyf (green grape) and the Steen-druyf (stone grape). The Haenapop (has-no-pip) is easily recognized as the Persian vine, yielding the stoneless Sultana raisins ; such raisins are also made in large quantities at the Cape. There is also the vine yielding the Lachrymæ Christi, which at the Cape bears this name.

PECULIARITIES OF CULTIVATION.

The methods of cultivation are those usual in the countries from which the several vines are derived, modified however by several circumstances. During the dry season the vines would drop their fruit, if they were not irrigated. With the help of water, however, they grow to beautiful size and perfection. Nevertheless the wines do not become very strong, perhaps as some allege, who oppose the irrigation altogether, because it is too long continued, and the grapes are therefore never sufficiently cooked by the hot sun and soil. However, as the Constantia vineyards are regularly irrigated, there must be means of obviating the disadvantageous effect of the process, which for the main growth of the plant and fruit seems to be absolutely essential.

VINTAGE AND VINIFICATION.

Before the vintage, the proprietors have to battle with many enemies. The Kaffirs rob their vineyards on the largest scale, and make wine and raisins from the product of their robberies. Many grapes are devoured by wild dogs, Cape badgers, and monkeys, and sometimes enormous flights of birds appear, and consume or damage and defile a great number of bunches of grapes. The proprietors of great estates collect and treat the harvest according to the rules of Europe; but many of the boors perform this part very negligently. They maintain that bad wine sells better than good, and do not take the trouble to make any selection. All kinds of grapes, ripe and unripe, rotten and hard, are pressed together; to the red grapes some French Pontac is mixed already at the time of fermentation. The casks used at the Cape are all imported, as the wood of indigenous trees—such as the Cuyaten, Geelhout, and cedar—cannot be used for wine casks, owing to its containing certain aromatic oils of which the taste would contaminate the wine. The fermented wines are sulphured, either by fumes, or by the admixture of flowers of sulphur; freshly-killed meat is hung up in them, for who knows what purpose; lastly, they are dosed with Cape-smoke, so called, *i.e.* indigenous brandy. Having thus protected his wine from acetification with great difficulty,—for he possesses no cellars, and is obliged to keep his barrels in thatched huts above ground,—the boor sells it to the trader. This latter now begins to metamorphose the Cape wine into South African port and sherry.

QUALIFICATION OF CAPE WINES.

The sweet, pale-red Constantias are liqueur wines of the second class; they soon lose the muscat flavour, but gain ripeness instead. A simmered wine called Kokwyn, made from muscat grapes, resembles Malaga, and belongs to the third class. The red wines called dry Pontac and Burgundy, made from the relative grapes, are wines of the third class, when properly prepared, but mostly do not rise above the fifth class. The Cape hock of the village of Paarl in the valley of Drakenstein is a very characteristic wine, which belongs to the fourth and third classes of white wines. The anonymous wines of South Africa are also red and white, the latter being dry. They have none of the earthy or slaty taste, so often complained of, if properly prepared. It is probable that the worst faults of which Cape wines are susceptible are the result of their being in too many instances made by the almost unaided efforts of ignorant Kaffirs or negroes.

IMPORTS OF CAPE WINE INTO ENGLAND.

In 1859 the importation of Cape wine into England had, owing to the differential duty in favour of the colonies, risen to 781,581 gallons. After the reduction of the wine duties in 1860 the importation fell in 1862 to 182,282 gallons, or from 10·84 per cent. of the whole imports of wine in 1859 to 1·8 per cent. of the imports in 1862, and is at present still more contracted. The whole of this wine was, and is at present, used to produce strong brandied liquids in imitation of sherry and port. It is at least very difficult to obtain pure Cape wine in England; and if we have been able to study a few authentic specimens, it is only through the favour of friends that we have thus succeeded. It is to be desired that good, pure natural Cape wines should be accessible to the public through reliable trade channels.

PRINCIPAL VITICULTURAL DISTRICTS AND ESTATES.

Stellenbosh, a considerable wine district north of False Bay, is so named from a former governor, Van der Stell, and the bushes that covered it. He acquired large portions of territory in that locality, and constructed a reservoir in the mountains to irrigate his farms and vines during the exhaustive dry season, conveying the water in a channel by his wine stores to a mill where he ground his corn.

Drakenstein, another settlement north-east of Stellenbosh, was founded by a colony of French refugees on the revocation of the Edict of Nantes in 1685. Land more applicable for the growth of corn was indiscriminately appropriated to the use of the grape. The neighbouring Dutch farmers imitated the cultivation of the vine, but notwithstanding they had before their eyes, in the fine plantations of Constantia, the beneficial results of appropriate soil and site, they omitted to profit by the example and to select the fittest locality for their vine grounds, but persevered in establishing them as convenience prompted, or wherever they were likely to gather the heaviest crop.

On the western side of the valley of Drakenstein stands the village of Paarl, surrounded by a fertile tract of land, and especially distinguished by a curious mass of granite, surmounted by a number of large pebbly stones like the pearls of a necklace, to which it owes its name. Here the best dry white wines, so-called Cape hocks, are produced.

The Constantias.—The most celebrated growths of the Cape are three estates, termed respectively High Constantia, Great Constantia, and Little Constantia, so named after the wife of the Dutch Governor Van der Stell already mentioned, their founder. The plantations are situated at the eastern base of Table Mountain, about eight miles from Cape Town and midway between False and Table Bays. The vineyards are all upon very gentle slopes, just sufficiently inclined to admit of the distribution of water by irrigation channels. The soil of High Constantia is a red ochrous chalky marl; that of Great and Little Constantia is a white sandy gravel, with chalk. The latter soils are by some considered to yield a better product than the soil of High Constantia, but the differences, if any, are not very great. The prevailing vine is the red muscat of Frontignan, which gives to all Constantia wines their peculiar character. There are also a few other varieties of vines grown here, but, with the exception of the Rhenish vine, they produce no characteristic products. The vines are completely separated in different fields, by hedges, and there are no mixed sets. The vineyards have a surface of about 250 acres, or 101 hectares, and produce annually from 700 to 800 hectolitres of wine. The vintage is conducted with much care, the grapes being freed from the stalks, and blemished fruit and other impurities removed before they are pressed. The rest of the treatment of the must and wine is like that adopted at Frontignan; owing to the limited quantities of the product, its price is well maintained. Constantia wine is an exception to the rule that good things are not valued in the land of their birth; for it commands such high prices at Cape Town, and is so little valued in London, that a cargo of genuine wine, which had been brought to London in 1858, was taken back to the Cape, and realized better prices than had been offered at London, the double freight and other expenses notwithstanding.

Thus it is seen that the Constantia begins to share the fate of all sweet liqueur wines; they are so easily falsified, or imitated, that the genuine products themselves can no longer be distinguished with certainty, and are consequently distrusted and neglected. Another notable estate near Constantia is Witteboom, which also produces red muscats resembling those of its neighbours. Seal Island in Table Bay also produces some good wines.

THE VINE IN OTHER PARTS OF AFRICA.

Madagascar has an indigenous vine, which the natives declare to bear a poisonous fruit. Considering that there is an American vine whose husk inflames the lips, we ought not to ascribe this allegation to Mahometan prejudice without inquiry, even although some Frenchmen in their settlements of Fort Dauphin, Port Louis, Nossebel, and Mayotta (Isle of Comoren), made wine of that grape, which was innocuous. Isle de France and Bourbon cultivate the vine only for its grapes in gardens, and have abandoned attempts for its more extensive cultivation, which, though viticulturally successful, were opposed by difficulties in the vinification.

In Morocco the vine is cultivated down to 33° latitude. The grapes grow large, full and sweet; they are reared on espaliers and made to form arched, covered walks, so as to keep the soil shaded; the land has, however, to be irrigated. The gardens are surrounded by hedges of prickly pear cactus. The largest of the seven principal varieties of grapes is called "hen's egg," and is supposed to be identical with the Spanish teta de vaca. Wine is only made by the Jews; it is light and acidulous, is kept in large earthenware jars and in skins, and does not keep beyond one year. The best and largest amount of wine is made at Uadnum, Tarodante, and Tangiers. In the district of Mogador excellent raisins are made.

Algeria possessed in the year 1860 only about 220 hectares of vineyards, of which the province of Alger contained 145; that of Oran, 70; and Constantine a small rest. In 1870 it was stated that Oran then had reared 3,200 hectares of vineyard, and that the wines resembled the small wines of Languedoc. The late revolt will have changed the prospects of this enterprise to some extent. In ancient times the valley of the Nile produced the wines of Arsinoë, Mendes, Koptos, and Mareotis; its Delta, the liqueur wine of Sebenytus, of which latter large quantities were exported to Rome: since the spread of Islamism only grapes and raisins are produced. At Fayum, near the Lakes Moeris and Medineh, the vines grow luxuriously. Raisins are made at Djeddie, Denderah, Kous, Farshout, Marach, and Ain-Tab.

CHAPTER XXVI.

THE VINES AND WINES OF AMERICA.

Historical notes on the cultivation of the vine in North America.—The wild or indigenous vines of North America: Fox-grape, Summer-grape, Caribæan grape, Mustang vine, Californian vine, Frost grape, River grape, Scuppernong, Mountain grape, Texan mountain grape, Post-oak grape.—Cultivation of the vine in America.—Variation of vines cultivated in North America.—Cultivation of vines foreign to America.—Vinification in the United States.—Statistical notes on the production of wine in North America.—Extent of trade in sparkling Catawba.—Acreage under viticulture.—Years of good and bad vintages in North America.

HISTORICAL NOTES ON THE CULTIVATION OF THE VINE IN NORTH AMERICA.

THE first attempts to cultivate the vine were made in 1564, with an indigenous vine of Florida.

A French traveller, of the name of Dufour, who planted many vines after 1805, reported that a Frenchman was in the habit of collecting the grapes from the vines which grow wild on the islands of the Ohio, and to produce a few barrels full of wine, which was estimated as good as wine grown in the neighbourhood of Paris. It was then supposed that these vines were of French origin, but Dufour found them wild in Kentucky and other parts.

In 1796, Dufour had visited all the places where viticulture had been attempted, up to Kaskaskia on the Mississippi. None deserved in his opinion the name of vineyard. In the last named locality some Jesuits had made a plantation, which the

French Government of that day caused to be destroyed for fear of its making competition to the wines of France.

Major Adlum, Mr. Longworth, some Swiss emigrants at Vévay, and some proprietors in Carolina, recognized that the vines from Europe would not succeed, and that recourse must be had to indigenous plants. Viticulture rose, so that on the Ohio, now termed the Rhine of North America, there are upwards of 1550 acres of vineyards under cultivation.

In 1830, Prince enumerated more than 88 varieties of American vines; but only few, to be mentioned hereafter, are cultivated either for wine-making or eating.

THE WILD OR INDIGENOUS VINES OF NORTH AMERICA.

The learned memoir with which M. des Moulins has prefaced his translation of Durand's monograph should be perused by all students of botany, and particularly by readers interested in the history of the botanical literature on the vine. The French viticulturists turned their attention to American vines, when the oïdium was destroying their own. Many varieties of vines were consequently brought to France and cultivated; and if the primary object failed, in so far as no good wine could be produced from any of them, yet scientific botany gained great advantages. Thus we had the satisfaction of seeing an almost complete collection of known American vines in the botanical garden at Bordeaux. Some of them, yet young, had not borne fruit; others were bearing largely, particularly the varieties long since cultivated in America and known in Europe.

We give the following characteristics of American indigenous vines after Durand, but avoid adding the many synonyms, and prefer to relate the diagnoses in such English as it is possible to translate botanical Latin into.

The vines are either polygamic or dioic. Durand attributes no importance to this circumstance, and thinks that any variety may become either, or be both. He therefore differs from Bronner, who believes the dioic condition to be characteristic of the wild vines. All the vines given in the following are true vines, and have petals which cohere at the apex, and are pushed off like a little cap, by the five stamina; the stylus is short and conical; the leaves are simple; the branches very long and creeping.

FIRST SECTION.—*Leaves on their lower surface woolly, or felted as if with a spider's web.*

1. *Vitis Labrusca* (L.).—The Americans term it fox-grape, or northern fox-grape. The leaves are of a broad heart-shape, either almost entire, or trilobed, denticulated; their under-face, as well as the leaf-stalks and young branches or shoots, covered with a whitish or yellowish felt; bunch-stalks of grapes rather short and simple; berries, large purple-black, very rarely becoming of a pale green, amber, or red colour. The berries have nearly the same taste and flavour or odour as the black currants (*Ribes niger*), and ripen at the end of August or beginning of September. The plant occurs in the whole of North America, which lies between the Atlantic Ocean and the Rocky Mountains. Its long branches cover hedges and rise to the tops of the highest trees. The berries are round and large, sometimes attaining the size of a damson; the stalks are short and provided with few berries, almost always simple, or bearing a single small sub-grape at the base. The berry is generally black, and covered with an abundant bloom. The taste of the grape, though similar to the black currant, is sometimes more soft and less perfumed. The pulp is tenacious, and does not easily melt in the mouth; it slips on pressure as an entire lump out of the thin hard skin. Although these wild grapes are very bad to eat, to the taste of Europeans, the Americans are very fond of them, and pay high prices for them in the markets.

It is assumed, that from this *V. Labrusca* a variety of pure and hybrid races of vines have been produced by cultivation, namely, the Isabella, Catawba, Schuylkill, Alexander, Bland's grape, and others, mentioned amongst the cultivated varieties. It has been proposed to plant the *V. Labrusca* and use it as a footing for grafting thereon the European varieties. We are of opinion that this proposition should be tried on a large scale, as we believe the great vegetative and root-power of this vine will greatly develop the grafts. The Labrusca is not subject to the oïdium, even when its branches interleave with those of ordinary vines affected by this parasite.

2. *Vitis æstivalis* (Michaux).—Summer grape, Chicken grape, Little grape. There are two varieties, the genuine and the sinuated. The *genuine* has leaves of a broad heart-shape, with unequally denticulated margins; they are entire, or divided in three or five lobes; the lobes are pointed; the young leaves are felted on the lower face; the bunches are oblong and compound; berries saturated sky-blue, smaller than those of Labrusca. They have an agreeable taste, and ripen in October, although the grape is called summer-grape for reasons unknown. The plant is found in the Atlantic region, on the Mississippi, and beyond to the Occident. The *sinuated* variety is distinguished by its leaves, which are sinuated like the hand, the lobes being divided by deep rhomboidal bays. The berries are small, and have a most agreeable but austere (Chapman) taste, and a dark sky-blue colour. It is found in the South Atlantic regions up to Louisiana, where it is called Pine-wood grape. The *Vitis æstivalis* is less vigorous than the Labrusca; and although it mounts up trees, yet its sinuate variety frequently remains creeping on the ground. From this latter the Delaware grape is derived.

The leaves of the *V. Labrusca* and *V. æstivalis* are so variable, that no distinction can be established by their aid alone. Their most characteristic differences are in the fruit.

3. *Vitis Caribæa* (De Candolle).—Has nearly round, scarcely heart-shaped, mostly entire, rarely three-lobed leaves, with a wide but not deep stalk-sinus; their margins are toothed in undulating lines; the leaves bear a sharp point; their surface is smooth, their lower face is like the surface of the new branches, leaf and fruit stalks covered with a film; the grapes are compound, and a little longer than the leaves; the berries rather large, purple-black, little juicy, and sour. It lives in Florida, South Arkansas, and Mexico, and is very common on the Antilles.

4. *Vitis candicans* (Engelmann).—This is the Mustang grape of New Mexico, Texas, and Arkansas. Its leaves are heart-shaped, and may be three- or five-lobed, or not; they are toothed by undulating lines, and have no sharp point; their surface is saturated green and naked; their lower sides and the stalks and new branches are white-grey, woolly. The grapes are dense, compound, and shorter than the leaves, and have large purple-black berries. The husks of the berries contain a very red and extremely acid juice; the pulp, however, has a softer, not burning taste, and is eatable. This vine is a great plague of the countries in which it lives, and destroys the greatest trees in the wild forests, as well as in plantations. It bears great numbers of grapes, a plant of eight years having given to Professor Buckley 54 gallons (245·3 litres) of juice. The wine obtained by direct fermentation is acid and poor. There should therefore be made an addition of three pounds of sugar to each gallon of must; and after complete fermentation and filtration, 10 per cent. of proof spirit should be added to the wine bottled. A good strong-bodied, agreeable, and nicely-coloured wine is thus obtained.

About five varieties of this vine are known; some have a white pulp, others a blood-red pulp; the grapes of both are externally black, when ripe. It blossoms in April, and ripens in July and August.

Only half the number of plants encountered in the forests are fertile, so that the vine is evidently regularly dioic, or divided into plants of the male and the female sex. The plant grows rapidly. Buckley saw some stems which were two feet English in circumference; their branches extended over five or six trees, each from 70 to 80 feet high. It is probable that if this vigorous plant were used as the stock, or basis or foot for grafts, great advantages might accrue.

In Texas the plant reaches a great size, some trees of from 18 to 20 inches in diameter having been cut down. Its fertility is enormous. At the time of ripeness one sees but one black mass of grapes, which covers all the leaves. The taste of the grapes is detestable, owing to an acid principle contained in the husk, which inflames the lips and the mucous membrane of the mouth. The husk is easily taken off with the fingers, and then the pulp may be eaten with advantage.

5. *Vitis Californica* (Bentham).—This vine has roundish, pointed leaves with large teeth; they are entire, or three- to five-lobed; at the basis they are profoundly cut out; smooth on the surface, they are below flaky and felted; the berries are small and black. The plant is very vigorous; the taste of the berry agreeable. It is common in California, Sonora, and in the eastern part of New Mexico.

SECOND SECTION.—*Leaves either quite smooth on both sides, or slightly downy underneath.*

6. *Vitis cordifolia* (Michaux).—This vine inhabits the whole of the Atlantic region of America to the Rocky Mountains. It occurs in two varieties, the genuine one, and the one which lives on the banks of rivers.

The *V. cordifolia genuina* is also termed fox-grape,—winter and frost grape. Its leaves are smooth on both sides, with unequal teeth; the very young leaves are downy, but become quickly smooth and shining; the bunches of fruit are long, sometimes a foot in length, and not very full of berries; the latter are black, small, and late. This vine is more feeble than the *Labrusca* and *æstivalis*. Its young branches are often very red, its leaves pale on the underside. The bunch is frequently very poor, on account of the many sterile flowers. The husks of the berries are very thin. The taste is acid, and like that of black currants. The vines overgrow entire trees, and flights of wild turkeys frequently settle upon them to eat their fruit. (Blooms, in the Review entitled "The Correspondent from Texas.")

The second variety is the *riparia*, or river grape (Texas) and sweet-scented grape; by French immigrants termed *Vigne des battures*. The leaves have unequally incised teeth, are three- to five-lobed; the lobes and teeth are pointed; their under face, stalks, nerves, and margins are downy; bunch and grapes are similar to those of the genuine variety, but more acid to the taste. The juice is blood-red, and becomes soft in taste after having been frozen. The grape contains only one kernel. It blossoms in May. The flowers have the odour of mignonette. The *odoratissima* variety is nothing else but the sterile male plant. The numbers of its flowers are astonishing. It grows on the banks of rivers, frequently creeping over rocks, shrubs, and trees.

7. *Vitis rotundifolia* (Michaux).—The Americans term it Bullace, Bullet-grape, Scuppernong, Southern fox-grape; the Texas people also call it Muscadine, which is bad and non-significant. Its leaves are small, of a shape somewhat between a kidney and a heart, smooth on both sides; its bunches are small; the berries have a great odour, and a purple, sometimes amber colour, a hard skin, and an agreeable taste. There is a small form of this vine which grows in sandy soil lying on the ground, with an acid fruit, in Florida termed Mustang-grape. The main variety is an elegant creeper, with a thin whitish bark, which rises to the top of the highest trees. The surface of the leaves is more shining than the lower one. It grows in marshes and on the banks of rivers in Virginia, Florida, Texas, and North Mexico. It has been cultivated a long time under the name of Scuppernong, as an eating grape and for making wine. In the States named, it takes the place which the Catawba holds in the North. To the north of the Potomac it remains sterile, and is frequently destroyed by the frost. It blossoms at the end of April; its large berries are delicious; the bunch is small.

THIRD SECTION.—*The shoots are erect or decumbent.*

8. *Vitis rupestris* (Scheele).—Commonly termed mountain-grape. This plant has a short smooth stem, three to four feet long, and short branches; its leaves are heart-kidney shaped, largely toothed, mostly tri-lobed, smooth on both sides; only the nerves of the young leaves are downy; the fruit-stalks are nearly simple, thin, and erect; the berries are small and purple-black. They ripen early, and have an agreeable taste. The plant grows in chalky soil on the banks of rivers in Texas and Arkansas.

9. *Vitis monticola* (Buckley).—The branches are from three to five feet long, and hanging down. Leaves heart-shaped,

with a deep narrow stalk-bay; their teeth broad; surfaces rather smooth; the shoots, stalks, and nerves of leaves are flaky and felted; the bunches are compound and strong, equal in length to the leaves, with large, closely grown, white or amber-coloured berries. This grape has the most agreeable taste of all American vines. It grows in Texas and to the north of it.

10. *Vitis Lincecumii* (Buckley).—The Texans term it post-oak grape, or pine-wood grape. Its branches are mostly hanging, four to five feet long, rarely climbing; the leaves are large, of a broad heart shape, with large teeth, and five lobes, the lobes obtuse, separated by deep sinuses, their surface webbed and hairy, their lower face felted; bunches compound, with great purple-black, sometimes amber-coloured berries. The berries have an agreeable odour and ripen in August. It grows in Texas, Western Louisiana, and Arkansas. It was hitherto mistaken for a variety of *V. Labrusca*. Buckley diagnosed its peculiarity, and gave it its surname in honour of the Texan doctor Lincecum. Its felt is of a reddish-yellow colour; its bunch is large, but shorter than the very large leaves. The vine is termed post-oak grape, because it grows by preference in the sandy soil of the Texan post-oak forests (*Quercus obtusiloba*, Mich.).

Durand includes the species of *Cissus* amongst the Vites, terming the above "true vines;" the *Cissi*, "Pseudo-vites." We prefer to allot the name Cissus to the varieties of *indivisa, incisa, acida, arborea,* and *quinquefolia.* The last variety (the *hedera*, or *Ampelopsis quinquefolia*) is the Virginia creeper, known as an ornamental plant, with an autumnal change of its leaves to a red colour, in all gardens of Europe.

CULTIVATION OF THE VINE IN AMERICA.

The Americans prefer chalky marl soil, if possible mixed with gravel, and undulating hilly territory with southern exposure for the cultivation of the vine. Sandy soils they find predispose the grapes less to rot, but their wines are wanting in sugar and richness. All trees are removed from the vineyard and a belt of 100 feet around it. The soil is grubbed by means of the mattock and drained. As the American vines have distant nodes and a greatly developed foliage, they cannot be planted so near as European vines; 3 feet by 6 on slopes, and 4 feet by 7 on plains, is the usual distance. Plantations are mostly effected by blind canes, rooted plants not being favoured. The soil is dug round with the mattock, here called "German hoe." In the spring next after planting, the young vine is cut down to one eye, and protected by a stake of acacia wood. In the second spring the vine gets two or three eyes; in the third, four or five eyes are left distributed on two spurs, which are trained to canes. In the fourth year the vine is cut for bearing. The strongest cane is left with six to eight eyes and fixed in an arc to the stake, or tied to the next stake. The bow is not allowed to retain more than ten, or if it be strong, fifteen grapes. All the new shoots of the bow are broken off one node above the last grape; all barren branches are removed entirely. This mode of cutting is repeated every year. The spur shoots the new canes, of which one gives the bearing cane, the other the spur; while the bow is not permitted to grow long wood, and in spring is entirely cut off.

VARIETIES OF VINES CULTIVATED IN NORTH AMERICA.[1]

1. The Catawba was discovered in 1802, in Buncombe County, North Carolina, under 35° 30′ N. latitude, in poor gravelly soil, and first made known in America as a wine-producing vine by Major Adlum, who claimed to have done a greater service to his country by his discovery than if he had extinguished the national debt. The Catawba is found wild along the Arkansas river, and is cultivated towards the north to the 42° of latitude. It forms nineteen-twentieths of the vines in the vineyards of the State of Ohio. It is without a rival in the production of American wine. M. Longworth of Cincinnati offered a prize of 500 dollars for the discovery of a better variety, but the prize has not been taken. The Catawba wine is good and dry, it can be made effervescent, and is

[1] Durand, Bullet. d'Acclimatat., t. ix., Avril 1862.

naturally either colourless, or straw-yellow, or of a rose colour, according to age and treatment of the grape. When the grapes are well ripe, it is not necessary to add sugar to the must. Longfellow wrote an enthusiastic poem in praise of Catawba wine. According to Durand, the Catawba is a variety produced by cultivation from the *fox-grape* or *Northern fox-grape* (*V. Labrusca*, L.) indigenous to America.

2. The Cape grape, also termed Alexander or Schuylkill Muscadel, is indigenous to the environs of Philadelphia, Pennsylvania. It was formerly as extensively cultivated as the Catawba; but as its must always requires an addition of sugar, it is being more and more abandoned by cultivators.

3. The Isabella, although stated by botanists to be a variety of *V. Labrusca*, is indigenous to South Carolina. It grows better in the north than in the middle States. Thus in Ohio it is frequently injured in its young wood by frosts, while on the shores of Lake Erie and in the neighbourhood of New York it bears amply and ripens well, and is therefore employed for cultivation on a large scale, particularly for eating, not for wine-making. If used for wine, from eighteen to twenty-four ounces of sugar have to be added to the gallon of must. It gives a wine which resembles light Madeira. Its grapes are subject to become mildewed, but not so easily rotten.

4. Bland's Madeira. The grape is delicious for eating, but the vine is not sufficiently hardy to be cultivated in Ohio.

5. Ohio or cigar box. Yields a handsome, black, soft, melting grape with small berries. It must be cut very long, and cannot easily be cultivated on a large scale. Its wine is dark red and has little perfume when young, but improves by age.

6. Lenoir. This vine yields a sweet and nicely flavoured, melting, black-berried grape. It is subject to mildew and rot particularly when it stands in clayey soil.

7. Missouri. Berry black, melting, soft, and agreeable. It is planted in vineyards because it yields an excellent wine, which has some feeble resemblance to Madeira.

8. Norton's Seedling. Berry purple, small, soft, but not melting. Gives wine of inferior quality.

9. Herbemont's Madeira. Good grape for eating, with small black berries, melting. Good wine of a rosy or light red colour, reminding of the taste of Manzanilla of Spain.

10. Minor's Seedling. A new grape, which may perhaps do well for mixing with other grapes to make wine, as its taste is highly muscat and otherwise high, too strong for being used undiluted. It is robust and not subject to rot; its berry is large and very juicy.

11. White Catawba. This is a white variety of No. 1, but much inferior to though derived from it. Its berries are large and juicy. No attempts have yet been made to produce wine from it.

12. Mammoth Catawba. This derivate preserves the colour of the original Catawba, less its taste. Its berry is very large and juicy, but has a tendency to detach itself from the stalk before being ripe.

13. The Scuppernong is a vine of southern origin, and can hardly be cultivated north of the 35° of latitude.

CULTIVATION OF VINES FOREIGN TO AMERICA.

Longworth has studied them for more than thirty years, as well as regards their qualities for wine-making as for eating. He cultivated numerous varieties from Paris, Bordeaux, and 6,000 plants from Madeira. After some years he was obliged to tear them out, as not one of them returned the expenses of its cultivation. It is therefore probable that the Americans may have to rely entirely upon their own indigenous varieties of vines for producing, by crossing, grafting, and seedling, such plants as will yield wine. The Catawba is derived from the fox-grape (*V. Labrusca*), as probably all varieties which are confined to special districts in Europe are derived from wild varieties which grew originally in those districts. Even the vines indigenous to America have no great duration in regular vineyards, being exhausted in from fifteen to twenty-seven years.

VINIFICATION IN THE UNITED STATES.

The machinery is very perfect. For all white and liqueur-like wines the grapes are collected in a very advanced state of maturity. The berries are separated from the stalks by means of metal sieves.

Vats or very large casks appear not to be known or used. The must is immediately run into small barrels, allowed to ferment, and racked a first time in February or March. The treatment in the casks offers no peculiarities, but is a great deal easier than that which is required in Europe: for the American wines have little or no tendency to acetous or viscous fermentation. A second fermentation takes place in the first summer of the wine, subsequently to which it clears up and becomes, after racking, a saleable article.

Catawba wine, three years old, quite pure, contains from 10 to 11·05 per cent. of alcohol. Red Cape contains 8·5 to 9·12 per cent.

STATISTICAL NOTES ON THE PRODUCTION OF WINE IN NORTH AMERICA.

The vineyards in the United States are mostly cultivated by Germans from the Rhine countries. They farm from ten to twenty acres from the proprietors, and pay half the vintage as their annual rent.

A vineyard of six acres, containing 14,400 vines, costs, from the beginning of the grubbing to the end of the second year after planting, 300 dols. per acre, purchase money included. (Buchanan.) A vineyard of a M. Resor's, of about an acre in extent, planted with vines at distances of 3′ by 6′, contained in 1837, when it commenced to bear, 1,755 vines, being Isabella, Cape, and Catawba. In 1841 the Isabellas had been removed, and the vineyard then contained 2,300 vines, half Catawba, half Cape. During the time from 1837 to 1845, the vintages in this vineyard were all between the 5th and the 20th of September. In these nine years there were obtained wine—

From the Catawba . . .	1,640 gallons,
,, Cape . . .	2,680 ,,
Total .	4,320 gallons,

or 480 gallons of wine per acre per year on an average. During all this time the vineyard had received no manure, but had been cultivated with the mattock and kept very clean. The 4,320 gallons of wine sold at 75 cents the gallon.

The making of the wine, collecting of grapes, pressing and barrelling, costs from 25 dols. to 30 dols. per acre. The acre when planted at distances of 3′ by 6′ contains 2,420 vines, and in bad years gives 200 gallons of wine; in good years the vintage may yield 400, but the average of ten years should not be put higher than 250 gallons. Buchanan calculates as follows the cost and annual return of an acre of vineyard in Cincinnati county:—

Annual interest of value of ground, estimated at 250 dols. . .	15 dols.
Annual cultivation	60 ,,
Making of wine, annually	25 ,,
Total expense .	100 dols.
Sale of 200 gallons of wine at 1 dol. per gallon	200 dols.
Annual net profit per acre	100 dols.

Of course, if the gallon of wine fetches only 75 cents, the profit per acre sinks to 50 dols.

EXTENT OF TRADE IN SPARKLING CATAWBA.

The trade in American wines is already considerable. Longworth has a capital of 100,000*l.* engaged in his various undertakings. In 1850 he prepared 60,000 bottles of sparkling Catawba; in 1851, 75,000; and in 1852, 100,000; and other houses produced 10, 20, 30, 60, 80 thousand bottles of sparkling and still Catawba.

ACREAGE UNDER VITICULTURE.

In a circle of twenty miles round Cincinnati there were a few years ago 1,200 acres of vineyards, which had cost, independently of the purchase of the soil, 200 dols. per acre, or together 240,000 dols. They produced about 200 gallons per acre, or, in the year, altogether 240,000 gallons of wine.

Next to Cincinnati the most important vineyards are in

Ohio, Missouri, Indiana, Western Virginia, the State of New York, Pennsylvania, Maryland, and Carolina. Brocton, a place fifty miles westward of Buffalo, upon the border of Lake Erie, has long been known for its superior wines and grapes. The cultivation of the latter has lately been extended there by a religious sect of communist separatists, of whom Laurence Oliphant (late British Ambassador in Japan) and a Mr. Harris are prominent members. A property of 1,600 acres is almost exclusively used for grape growing. The wines of California are making more rapid progress than those of Eastern America. The growths of Aliso and Angelico have already obtained some reputation. The firm of Sausserain and Co. produced in 1858: 9,400 gallons of white and 4,000 gallons red Aliso, 9,000 gallons Angelico, and 1,000 gallons of brandy; in all 23,400 gallons. The entire district of Angelos produced in the same year about 200,000 gallons of various wines. Some of the producers commit the mistake into which some Austrians have fallen, that of giving to their products classical names such as Steinberg, Porto, Champagne. They will do much better to retain their proper names and establish a reputation for original quality. A German company with considerable capital have established themselves near Angelos, and in a few years planted large districts with millions of vines. They have already shipped some of their product to Hamburg, and more is expected to arrive.

YEARS OF GOOD AND BAD VINTAGES IN NORTH AMERICA.

1852. There were strong frosts; the grapes rotted; the district of Cincinnati scarcely obtained 100 gallons per acre.

1853. Yielded 650 gallons per acre, and in well-cultivated vineyards up to 800 and 900 gallons. Was the best year since 1848.

CHAPTER XXVII.

THE WINES OF AUSTRALIA.

Historical note.—Peculiarities of Australian climate.—Densities of Australian must.—Viticulture in New South Wales.—Hunter River Vineyard Association.—Viticulture in South Australia.—Sale of the wines; shipments to Melbourne.—Australian Wine Company.—Viticulture in Victoria.—Description of Australian wines.—Importations of 1860 compared with those of 1870.—Progress.—Conclusion.

HISTORICAL NOTE.

THE founder of viticulture in Australia is an early colonist of New South Wales of the name of Busby. After having, up to 1830, been much engaged in furthering viticulture and the production of wine, and having distributed upwards of 20,000 vine-cuttings to fifty other settlers, he in 1831 undertook a journey to the vineyards of France and Spain in order to ascertain to what peculiarities of climate, soil, or culture, the most celebrated wine provinces are indebted for the excellence of their respective products, and to make a collection of the varieties of vines cultivated in each. He obtained cuttings from the collection of vines in the Botanical Gardens at Montpellier, counting 437 varieties. To these he subsequently added 137 from the Chaptal collection in the Jardin du Luxembourg at Paris, so that he had 574 varieties of cuttings at his disposal. Independently of these cuttings, he secured a competent quantity of all the most valuable varieties of vines which he found cultivated in the best wine districts of France and Spain, both for wine and raisins. He took all varieties he could obtain, as he feared that the best kinds of France and Spain might prove (and he asserted, in 1832, that several had already proved) of no value in New South Wales, while, on the other hand, indifferent kinds might produce in that climate valuable wines. He proposed to the then principal Secretary of State for the Colonies, that all these vines should be planted in an experimental garden at Sydney, to be established on vacant ground adjoining the Government garden, and under the direction of its superintendent. The desired accommodation was immediately granted, and the vines were sent to Australia by convict ships. Some twenty varieties from Northern Burgundy, Champagne, and Paris failed; but all the rest, about 550 in number, succeeded admirably. The names of all the varieties transported to Australia, Busby has recorded in the Journal of his travels.

Some other of the earliest vine-growers of Australia who deserve special notice, are Mr. James Macarthur and Mr. Patrick Auld. It is said that most of the present wine-growers in that colony are gentlemen of property, who are desirous rather of producing fine and creditable wines, than of obtaining large or immediate profits. Many, it is said, cultivate the art rather as an interesting scientific experiment, or with the view of making presents to their friends. The effect of this interest taken in the subject by a few respectable growers must be to establish the character of the wines, and to render their production a permanent and remunerative interest.

PECULIARITIES OF THE AUSTRALIAN CLIMATE.

The climate of South Australia is so warm that in most of its parts which are not elevated too high above the level of the sea, frost and snow but rarely or never occur. In some of its most favoured parts the orange-tree grows in the open air, and is cultivated, like the vine, for profitable production. The vine, therefore, does not often fail for lack of the necessary quantity and maximum of temperature. But the drawbacks of the Australian climate are the severe droughts and heavy rains to which it is alternately exposed, and which are as often destructive to the grapes as they are to other crops. The grapes begin to ripen about December, and then require some rain to attain their full development. Such rains the cultivators term vintage rains. When the rains fall upon the almost perfected grapes early in February, they are very detrimental. The grapes swell suddenly and burst, and lose their juice, or they begin to rot, and are quickly destroyed. Thus, in February 1860, the vintage at an estate called Camden Park, was totally ruined. The first heavy rain completely spoiled the lower part of the vineyard by floods, and a large portion of the grapes on the upper part of the vineyard burst, and the whole became rotten. In consequence, not a single gallon of wine was obtained. The effect of these rains upon the grapes is also well shown in the report of the Hunter River Association, which we have already printed on p. 642.

VITICULTURE IN NEW SOUTH WALES.

Since 1855 the larger portion of Australian wine has been produced in the Hunter River districts. There is a society in active operation, the Hunter River Vineyard Association, and the latest reports given at their annual meetings were satisfactory. Some wine-growers on the Hunter River state they obtain 300 gallons per acre.

The vintages of 1859 and 1860 were distributed over the four largest counties of the Hunter River district as follows:—

Counties.	1859.	1860.
	Gallons.	Gallons.
Durham	10,925	34,374
Hunter	2,850	2,345
Northumberland	4,326	13,555
Gloucester	5,194	10,140
Total	23,295	60,414

VITICULTURE IN SOUTH AUSTRALIA.

In 1859, South Australia produced 38,396 gallons of wine; in 1860, the Registrar-General gave 96,155 gallons as the quantity produced in that year. Number of acres under cultivation in 1858–59 = 1179; in 1859–60 = 1221; the number of acres include vineyards for growing eating grapes: only 584 acres were cultivated for wine. The average yield of an acre of vineyard is thus shown to be 164 gallons.

We are, however, informed that these official data are much below reality, and that in the district near Adelaide the following number of acres produced the stated quantities of wine in the years

1857.	1,056½	acres of vineyard	gave	100,624	gallons of wine.
1858.	1,626	,,	,,	140,970	,,
1859.	2,201	,,	,,	180,324	,,
1868.		,,	,,	900,000	,,

In this district the Auldana vineyards are situated, of which some very fine products are now sold in London.

Sale of the Wines.—The greater portion of the wines of South Australia is consumed in the neighbourhoods where it is grown. It is sold in the vineyards at from two shillings to five shillings per gallon, and is the almost exclusive beverage of the labouring people. The town populations, such as that of Maitland, do not appreciate or drink these wines. Sydney consumes some Camden wine, especially during hot weather. Shipments to the adjoining colony of Melbourne are carried out by the agency of the Australian Wine Company. They sold, in 1860, more than 3,000 dozen of the Irrawang and Kaludah wines.

VITICULTURE IN VICTORIA.

The colony of Victoria, with the capital Melbourne, was separated from New South Wales, capital Sydney, in 1851. All data concerning New South Wales, coming from a time before 1851, therefore include Victoria; all later ones may be considered to exclude it. It appears from the Statistical Register of Victoria, 1854, p. 363, and the Exhibition Catalogue, 1861, p. 59, that viticulture in that colony had progressed as follows:—

Year ending	Acres.	Produce.		
		Wine.	Brandy.	Eating Grapes.
		Gallons.	Gallons.	Cwts.
31st March, 1849 . .	108	6,306	100	—
,, 1850 . .		no	returns.	
,, 1851 . .	161½	4,621	286	—
,, 1852 . .	173½	6,447	450	—
,, 1853 . .	107¾	4,500	500	—
,, 1854—1858		no	returns.	
,, 1859 . .	547	7,740	—	—
,, 1860 . .	1,133	11,643	260	8,000
,, 1867, 1868	—	400,000	—	—

At the Exhibition of Victoria in 1861, fifty-seven different wines out of a total (number not stated, but probably reaching 100) exhibited, were placed by the jurors: five received first, twenty-six second-class certificates, and twenty-six others honourable mentions. The maximum number to be given to the best wine was fixed by the jurors at twenty, and no wine was placed which did not receive at least five numbers. No description of characteristics—except the names of the vines, colour of the wine, and, in about half the number, the year of growth—is given. (Official Catalogue, 1861, p. 282.)

We have no information regarding the manner in which the vines are trained in this or any other part of Australia. Many vineyards are ploughed or dug round but once a year, as labour is so very dear. In consequence they are filled with weeds, and the grapes are literally smothered by them. This explains much of the character of these wines; and the fact that vintagers here and in Adelaide sometimes receive ten shillings a day as wages, exhibits some of the financial difficulties of viticulture in this splendid country.

DESCRIPTION OF AUSTRALIAN WINES.

Products from a new country must be judged not only absolutely by reference to established standards, but also relatively with reference to their capability for improvement, if faulty or imperfect. By applying this process to Australian wines, we have come to the result, that many good qualities have already been obtained; that, if the processes of vinification were better, these qualities would be greatly enhanced; that many wines, evidently made from excellent grapes, are spoiled by faulty preparation, or by want of proper nursing. To prove these points a little more in detail, we extract from a publication on wines by Toovey, a few notes on Australian wines sent to England in 1860, and add thereto such other data on wines imported about ten years later as we have been able personally to obtain.

1. *Verdeilho.* Vintage 1857. Colour, partridge eye; taste, aromatic and nutty. Full body, contained 29·4 per cent. proof spirit; consequently was brandied. If this wine was made from the grape whose name it bears, it shows that the maker was unacquainted with the art of making red wine.

2. *Frontignac.* A thin, white wine, possessing a slight flavour of the muscat grape, being a fictitious elder-flower flavour. Alcohol = 29·4 per cent. proof spirit.

3. *White wine of* 1857. Agreeable, light, flavour of raspberries, which had probably been put into the must. Contained 26 per cent. proof spirit.

4. *Malbec.* Described as being made from "claret" grape. Similar to continental "claret." Stated to be 1857, but was probably of 1859. Had the character of Hungarian wine, and contained 23 per cent. proof spirit. It was damaged.

5. *Tavoora.* Described as a pure "port" wine of 1859; of which species a very large quantity was under cultivation in 1860. The grower, Mr. Patrick Auld, hoped that this wine would ultimately become one of their largest items of export. It contained 27·2 per cent. of proof spirit, and was therefore alcoholized.

6. *Red Wine.* Was out of condition, and contained 33 per cent. of proof spirit.

In 1870 we obtained the following wines from reliable sources:—

7. *Tintara.* A red wine, clear, with no particular character or flavour, somewhat brandied. Vines half Mataro, with Grenaches and others.

8. *Adelaide.* White, 60*s.* per dozen. An exquisitely pure white wine, mainly from Riessling grapes. But there are other strong-flavoured grapes admixed, which make a complicated but very fine and peculiar bouquet. *Soupçon* of muscatel; a little too fiery for greatness, though stated not to have been alcoholized. Equal to European wines of the second class. Would be better if the suspicion of muscatel could be left out.

9. *Adelaide.* White, 50*s.* per dozen. Wine of the same general character as the former, but less fine; a kind of "milieu" to the "tête," No. 8.

10. *Adelaide.* White, 42*s.* per dozen. The "queue" to the previous two wines; all the same qualities, but in lesser intensity.

11. *Adelaide.* White, 36*s.* per dozen.

12. *Adelaide.* White, 30*s.* per dozen. These wines have also the general character of Nos. 8, 9, and 10, but they are somewhat spoiled during vinification or transport, so as to have contracted a mousy taste, a flavour of volatile acidity, and the faculty of becoming darker on exposure to air. These faults could be easily remedied, and then the five qualities would stand, as to price, in proportion to each other and their relative value. But, compared to the absolute price of equivalent French and German wines, all five qualities are yet somewhat too dear.

13. *Wattlesville.* White, 24*s.* per dozen. An acidulous wine, of no particular quality.

14. *Adelaide.* Red, 48*s.* per dozen. This wine is full of vinosity, body, and of a peculiar mild flavour. It is somewhat too hot, though stated not to contain adventitious brandy. It is in its way equal to burgundies of the same price, third class; but resembles more the finer qualities of Hermitage, third class.

15. *Adelaide.* Red, 42*s.* per dozen. Similar to No. 14, but less fine; also a valuable wine, free from fault.

16. *Adelaide.* Red, 36*s.* per dozen.

17. *Adelaide.* Red, 30*s.* per dozen. These wines are similar in general character to Nos. 14 and 15, but have faults, such as mouse taste and acidity.

18. *Australian.* Place of growth unknown; 24*s.* per dozen; brownish unfavourable colour; not worth its price.

19. *Adelaide.* At 18*s.* per dozen.

20. *Wattlesville.* At 18*s.* per dozen. These wines are mousy, contain vinegar, and are naturally acid and unfavourably coloured.

21. *Sweet liqueur wine.* Sold in pints at 35*s.* per dozen. Feeble muscat flavour, pure, free from faults, but somewhat too acid.

In addition to these wines, of which Nos. 8 to 21 are imported by an active firm, we have tasted the wines of another importing house, as follows:—Muscatel, at 20*s.*, a thin wine, elder-flavoured; Tokay, 36*s.*; Chasselas, 40*s.*; Monalta claret, 18*s.* This house also imported formerly wines made from the Pedro Ximenes, Riessling, Shiraz, and Black Portugal grapes, and bearing these names; and others coming from the vineyards of Argaston, Bellvester, Buschefelde, Clarendon, Evanston, Glen Ewin, Highercombe, Inkermann, Morialta, Para-Para, Payneham, Pewsey Vale, Torrens Park, Seppefield, Tanunda, and others. But the inquiry and sale were so small that, after the first consignments were exhausted, no further importations took place. To many of these wines, which had been carelessly shipped, brandy had to be added after their arrival in England.

CONCLUSION.

From the foregoing we have no doubt that the best and better qualities of Australian wines will be able to obtain and hold a mercantile position by the side of the second and third classes of European growths. The medium and low qualities of these wines, however, are too faulty to be considered as probable mercantile objects, even if their prices were reduced to about one-half of those at present quoted. The Australian viticulturists should continue to find the most suitable situations, and the vines most advantageous for them. In view of the dearth of human labour they should so arrange their vineyards as to admit of their being cultivated with the plough. They should particularly care to keep their vineyards free from weeds, as these, even in warm climates, do not permit the grapes to attain perfect maturity or coloration, and stunt their development. The vines should be kept low and methodically pruned, and be broken back after the blossom. The proprietors should adhere to the practice of making wine from pure sets of grapes, and avoid mixing heterogeneous fruit together. They should carefully study and arrange all details of vinification, with a view of producing pure, natural, unbrandied wines, capable of lasting, and of being transported to any country and climate, a problem which, in these days of scientific progress, is easy of solution. They should notice of each vintage-wine the following points of character: the place and year in which it is made; the vines from which it is produced; if made from a mixed set, the proportion in which each variety is present in the whole. With such data wines become more valuable, because their probable development can be predicted, and consequently guided to a useful purpose. Indeed, if this enterprising branch of the Anglo-Saxon race were to establish large companies for the purpose of planting and purchasing vineyards, of buying grapes and manufacturing wine in a scientific manner, of buying sound young wines from single growers, and maturing them for sale, they might attain successes equal to the best of their achievements in gold, wool, or banking.

ALCOHOL OR SPIRIT TABLES.

TABLE I.

Showing percentages of absolute alcohol by weight and by volume, and percentages of proof spirit contained in mixtures of alcohol and water, at all specific gravities with four decimals, water being 1· *down to* ·9652, *at a temperature of* 15·5.

1.	2.	3.	4.	1.	2.	3.	4.
Specific gravity at 15·5 C.	Absolute alcohol per cent. by weight.	Absolute alcohol per cent. by volume.	Per-centage of proof spirit.	Specific gravity at 15·5 C.	Absolute alcohol per cent. by weight.	Absolute alcohol per cent. by volume.	Per-centage of proof spirit.
1·0000	0·00	0·00	0·00				
·9999	0·05	0·07	0·11	·9959	2·22	2·78	4·88
8	0·11	0·13	0·24	8	2·28	2·86	5·01
7	0·16	0·20	0·35	7	2·34	2·93	5·14
6	0·21	0·27	0·46	6	2·39	3·00	5·25
5	0·26	0·33	0·57	5	2·45	3·07	5·39
4	0·32	0·40	0·71	4	2·51	3·14	5·52
3	0·37	0·47	0·82	3	2·57	3·21	5·65
2	0·42	0·53	0·93	2	2·62	3·28	5·76
1	0·47	0·60	1·04	1	2·68	3·36	5·89
0	0·53	0·67	1·17	0	2·74	3·43	6·02
·9989	0·58	0·73	1·28	·9949	2·79	3·50	6·13
8	0·64	0·80	1·41	8	2·85	3·57	6·26
7	0·69	0·86	1·52	7	2·91	3·64	6·39
6	0·74	0·93	1·63	6	2·97	3·71	6·52
5	0·80	1·00	1·76	5	3·02	3·78	6·63
4	0·85	1·07	1·87	4	3·08	3·86	6·76
3	0·91	1·13	2·01	3	3·14	3·93	6·89
2	0·96	1·20	2·12	2	3·20	4·00	7·02
1	1·02	1·27	2·25	1	3·26	4·07	7·16
0	1·07	1·33	2·36	0	3·32	4·14	7·29
·9979	1·12	1·40	2·47	·9939	3·37	4·21	7·40
8	1·18	1·47	2·60	8	3·43	4·28	7·53
7	1·23	1·53	2·71	7	3·49	4·36	7·66
6	1·29	1·60	2·84	6	3·55	4·43	7·79
5	1·34	1·67	2·95	5	3·61	4·50	7·92
4	1·40	1·73	3·08	4	3·67	4·57	8·05
3	1·45	1·80	3·19	3	3·73	4·64	8·18
2	1·51	1·86	3·32	2	3·78	4·71	8·29
1	1·56	1·93	3·43	1	3·84	4·78	8·42
0	1·61	2·00	3·54	0	3·90	4·86	8·55
·9969	1·67	2·07	3·68	·9929	3·96	4·93	8·68
8	1·73	2·14	3·81	8	4·02	5·00	8·81
7	1·78	2·21	3·92	7	4·08	5·08	8·94
6	1·83	2·28	4·03	6	4·14	5·15	9·07
5	1·89	2·36	4·16	5	4·20	5·23	9·20
4	1·94	2·43	4·27	4	4·27	5·31	9·36
3	1·99	2·50	4·38	3	4·33	5·38	9·49
2	2·05	2·57	4·51	2	4·39	5·46	9·62
1	2·11	2·64	4·64	1	4·45	5·54	9·75
0	2·17	2·71	4·77	0	4·51	5·62	9·88

TABLE I.—*continued.*

1.	2.	3.	4.	1.	2.	3.	4.
Specific gravity at 15·5 C.	Absolute alcohol per cent by weight.	Absolute alcohol per cent. by volume.	Percentage of proof spirit.	Specific gravity at 15·5 C.	Absolute alcohol per cent. by weight.	Absolute alcohol per cent. by volume.	Percentage of proof spirit.
·9919	4·57	5·69	10·01	·9869	7·85	9·75	17·10
8	4·64	5·77	10·16	8	7·92	9·83	17·26
7	4·70	5·85	10·29	7	7·99	9·91	17·41
6	4·76	5·92	10·42	6	8·06	10·00	17·56
5	4·82	6·00	10·55	5	8·13	10·08	17·71
4	4·88	6·08	10·68	4	8·20	10·17	17·86
3	4·94	6·15	10·81	3	8·27	10·25	18·01
2	5·01	6·23	10·96	2	8·34	10·33	18·16
1	5·07	6·31	11·09	1	8·41	10·42	18·31
0	5·13	6·38	11·22	0	8·48	10·50	18·46
·9909	5·20	6·46	11·38	·9859	8·55	10·58	18·61
8	5·26	6·54	11·51	8	8·62	10·66	18·76
7	5·32	6·62	11·64	7	8·70	10·75	18·93
6	5·39	6·69	11·79	6	8·77	10·83	19·08
5	5·45	6·77	11·92	5	8·84	10·91	19·23
4	5·51	6·85	12·05	4	8·91	11·00	19·38
3	5·58	6·92	12·20	3	8·98	11·09	19·54
2	5·64	7·00	12·33	2	9·05	11·18	19·69
1	5·70	7·08	12·46	1	9·12	11·27	19·84
0	5·77	7·17	12·61	0	9·20	11·36	20·01
·9899	5·83	7·25	12·74	·9849	9·27	11·45	20·16
8	5·89	7·33	12·87	8	9·34	11·55	20·31
7	5·96	7·42	13·02	7	9·41	11·64	20·46
6	6·02	7·50	13·15	6	9·49	11·73	20·63
5	6·09	7·58	13·30	5	9·56	11·82	20·78
4	6·15	7·66	13·43	4	9·63	11·91	20·93
3	6·22	7·75	13·59	3	9·70	12·00	21·08
2	6·29	7·83	13·74	2	9·78	12·09	21·25
1	6·35	7·91	13·87	1	9·85	12·18	21·40
0	6·42	8·00	14·02	0	9·92	12·27	21·55
·9889	6·49	8·08	14·17	·9839	9·99	12·36	21·70
8	6·55	8·17	14·30	8	10·07	12·45	21·87
7	6·62	8·25	14·45	7	10·16	12·55	22·07
6	6·69	8·33	14·60	6	10·26	12·64	22·27
5	6·75	8·42	14·73	5	10·35	12·73	22·47
4	6·82	8·50	14·88	4	10·44	12·82	22·67
3	6·89	8·58	15·03	3	10·54	12·91	22·87
2	6·95	8·66	15·16	2	10·63	13·00	23·07
1	7·02	8·75	15·31	1	10·72	13·09	23·27
0	7·09	8·83	15·47	0	10·81	13·18	23·47
·9879	7·16	8·91	15·62	·9829	10·91	13·27	23·67
8	7·23	9·00	15·77	8	11·00	13·36	23·87
7	7·30	9·08	15·92	7	11·08	13·45	24·04
6	7·37	9·17	16·07	6	11·15	13·55	24·20
5	7·43	9·25	16·20	5	11·23	13·64	24·36
4	7·50	9·33	16·35	4	11·31	13·73	24·52
3	7·57	9·42	16·50	3	11·39	13·82	24·68
2	7·64	9·50	16·65	2	11·46	13·91	24·84
1	7·71	9·58	16·80	1	11·54	14·00	25·01
0	7·78	9·66	16·95	0	11·62	14·10	25·17

TABLE I.—*continued.*

1.	2.	3.	4.	1.	2.	3.	4.
Specific gravity at 15·5 C.	Absolute alcohol per cent. by weight.	Absolute alcohol per cent. by volume.	Per-centage of proof spirit.	Specific gravity at 15·5 C.	Absolute alcohol per cent. by weight.	Absolute alcohol per cent. by volume.	Per-centage of proof spirit.
·9819	11·69	14·20	25·34	·9769	15·66	19·10	33·96
8	11·77	14·30	25·50	8	15·75	19·20	34·14
7	11·85	14·40	25·66	7	15·83	19·30	34·32
6	11·92	14·50	25·83	6	15·91	19·40	34·50
5	12·00	14·60	26·00	5	16·00	19·50	34·66
4	12·08	14·70	26·16	4	16·08	19·60	34·82
3	12·15	14·80	26·33	3	16·17	19·70	34·97
2	12·23	14·90	26·49	2	16·25	19·80	35·14
1	12·31	15·00	26·66	1	16·33	19·90	35·30
0	12·39	15·09	26·82	0	16·42	20·00	35·46
·9809	12·46	15·18	26·98	·9759	16·50	20·10	35·62
8	12·54	15·27	27·15	8	16·58	20·20	35·77
7	12·62	15·36	27·31	7	16·66	20·30	35·95
6	12·69	15·45	27·48	6	16·75	20·40	36·11
5	12·77	15·55	27·64	5	16·83	20·50	36·37
4	12·85	15·64	27·80	4	16·91	20·60	36·43
3	12·92	15·73	27·97	3	17·00	20·70	36·61
2	13·00	15·82	28·13	2	17·08	20·80	36·78
1	13·08	15·91	28·29	1	17·17	20·90	36·96
0	13·15	16·00	28·46	0	17·25	21·00	37·13
·9799	13·23	16·10	28·62	·9749	17·33	21·10	37·31
8	13·31	16·20	28·79	8	17·42	21·20	37·48
7	13·39	16·30	28·95	7	17·50	21·30	37·66
6	13·46	16·40	29·11	6	17·58	21·40	37·83
5	13·54	16·50	29·28	5	17·66	21·50	38·01
4	13·62	16·60	29·44	4	17·75	21·60	38·18
3	13·69	16·70	29·61	3	17·83	21·70	38·36
2	13·77	16·80	29·77	2	17·91	21·80	38·53
1	13·85	16·90	29·93	1	18·00	21·90	38·71
0	13·92	17·00	30·10	0	18·08	22·00	38·87
·9789	14·00	17·10	30·26	·9739	18·15	22·09	39·03
8	14·08	17·20	30·45	8	18·23	22·18	39·19
7	14·17	17·30	30·64	7	18·31	22·27	39·35
6	14·25	17·40	30·84	6	18·38	22·36	39·51
5	14·33	17·50	31·03	5	18·46	22·45	39·67
4	14·42	17·60	31·22	4	18·54	22·54	39·83
3	14·50	17·70	31·41	3	18·62	22·64	40·00
2	14·58	17·80	31·60	2	18·69	22·73	40·16
1	14·66	17·90	31·79	1	18·77	22·82	40·32
0	14·75	18·00	31·99	0	18·85	22·91	40·48
·9779	14·83	18·10	32·18	·9729	18·92	23·00	40·64
8	14·91	18·20	32·38	8	19·00	23·10	40·81
7	15·00	18·30	32·56	7	19·08	23·20	40·98
6	15·08	18·40	32·73	6	19·17	23·30	41·16
5	15·17	18·50	32·91	5	19·25	23·40	41·33
4	15·25	18·60	33·08	4	19·33	23·50	41·51
3	15·33	18·70	33·26	3	19·42	23·60	41·68
2	15·42	18·80	33·43	2	19·50	23·70	41·85
1	15·50	18·90	33·61	1	19·58	23·80	42·03
0	15·58	19·00	33·78	0	19·66	23·90	42·20

TABLE I.—*continued.*

1.	2.	3.	4.
Specific gravity at 15·5 C.	Absolute alcohol per cent. by weight.	Absolute alcohol per cent. by volume.	Per-centage of proof spirit.
·9719	19·75	24·00	42·38
8	19·83	24·10	42·55
7	19·91	24·20	42·73
6	20·00	24·30	42·90
5	20·08	24·40	43·07
4	20·17	24·50	43·25
3	20·25	24·60	43·42
2	20·33	24·70	43·60
1	20·42	24·80	43·77
0	20·50	24·90	43·94
·9709	20·58	25·00	44·12
8	20·66	25·09	44·29
7	20·75	25·18	44·46
6	20·83	25·27	44·63
5	20·91	25·36	44·81
4	21·00	25·45	44·99
3	21·08	25·54	45·15
2	21·15	25·64	45·31
1	21·23	25·73	45·47
0	21·31	25·82	45·63
·9699	21·38	25·91	45·79
8	21·46	26·00	45·95
7	21·54	26·10	46·11
6	21·62	26·20	46·27
5	21·69	26·30	46·43
4	21·77	26·40	46·59
3	21·85	26·50	46·76
2	21·91	26·60	46·92
1	22·00	26·70	47·07
0	22·08	26·80	47·23
·9689	22·15	26·90	47·39
8	22·23	27·00	47·55
7	22·31	27·09	47·71
6	22·38	27·18	47·87
5	22·46	27·27	48·03
4	22·54	27·36	48·19
3	22·62	27·45	48·35
2	22·69	27·55	48·51
1	22·77	27·64	48·67
0	22·85	27·73	48·83
·9679	22·91	27·82	48·99
8	23·00	27·91	49·15
7	23·08	28·00	49·31
6	23·15	28·09	49·47
5	23·23	28·18	49·63
4	23·31	28·27	49·78
3	23·38	28·36	49·94
2	23·46	28·45	50·10
1	23·54	28·55	50·25
0	23·62	28·64	50·41
·9669	23·69	28·73	50·57
8	23·77	28·82	50·73
7	23·85	28·91	50·89
6	23·91	29·00	51·05
5	24·00	29·09	51·21
4	24·08	29·18	51·37
3	24·15	29·27	51·53
2	24·23	29·36	51·69
1	24·31	29·45	51·85
0	24·38	29·55	52·01
·9659	24·46	29·64	52·16
8	24·54	29·73	52·32
7	24·62	29·82	52·48
6	24·69	29·91	52·64
5	24·77	30·00	52·80
4	24·85	30·08	52·96
3	24·91	30·17	53·12
·9652	25·00	30·25	53·28
PROOF SPIRIT.			
·91984	49·24	57·06	100

TABLE II.

Giving the percentage of sugar, by weight in volume of solution, for all specific gravities with four decimals, from specific gravity 1·0040 *to specific gravity* 1·0250, *at a temperature of* 17·5° C.

Specific gravity.	Percentage.	Specific gravity.	Percentage.	Specific gravity.	Percentage.
1·0040	1·004	1·0085	2·143	1·0130	3·292
1	·029	6	·168	1	·318
2	·054	7	·194	2	·343
3	·080	8	·219	3	·369
4	·105	9	·245	4	·395
5	·130	1·0090	2·270	5	·420
6	·155	1	·295	6	·446
7	·180	2	·321	7	·472
8	·206	3	·346	8	·498
9	·231	4	·372	9	·523
1·0050	1·256	5	·397	1·0140	3·549
1	·281	6	·423	1	·575
2	·307	7	·448	2	·600
3	·332	8	·474	3	·626
4	·358	9	·499	4	·652
5	·383	1·0100	2·525	5	·677
6	·408	1	·550	6	·703
7	·434	2	·576	7	·729
8	·459	3	·601	8	·755
9	·485	4	·627	9	·780
1·0060	1·509	5	·652	1·0150	3·806
1	·534	6	·678	1	·832
2	·560	7	·703	2	·858
3	·585	8	·729	3	·883
4	·610	9	·754	4	·909
5	·635	1·0110	2·780	5	·935
6	·661	1	·805	6	·961
7	·686	2	·831	7	·987
8	·711	3	·856	8	4·012
9	·737	4	·882	9	·038
1·0070	1·762	5	·908	1·0160	4·064
1	·787	6	·934	1	·090
2	·813	7	·959	2	·116
3	·838	8	·985	3	·141
4	·864	9	3·010	4	·167
5	·889	1·0120	3·036	5	·193
6	·914	1	·062	6	·219
7	·940	2	·087	7	·245
8	·965	3	·113	8	·270
9	·991	4	·138	9	·296
1·0080	2·016	5	·164	1·0170	4·322
1	·041	6	·190	1	·347
2	·067	7	·215	2	·374
3	·092	8	·241	3	·400
4	·118	9	·266	4	·426

TABLE II.—*continued.*

Specific gravity.	Percentage.	Specific gravity.	Percentage.	Specific gravity.	Percentage.
1·0175	4·451	1·0200	5·100	1·0225	5·751
6	·477	1	·126	6	·778
7	·503	2	·152	7	·804
8	·529	3	·178	8	·830
9	·555	4	·204	9	·856
1·0180	4·581	5	·230	1·0230	5·882
1	·607	6	·256	1	·908
2	·633	7	·282	2	·934
3	·659	8	·308	3	·961
4	·685	9	·334	4	·987
5	·710	1·0210	5·360	5	6·013
6	·736	1	·386	6	·039
7	·762	2	·412	7	·065
8	·788	3	·438	8	·092
9	·814	4	·464	9	·118
1·0190	4·840	5	·490	1·0240	6·144
1	·866	6	·517	1	·170
2	·892	7	·543	2	·196
3	·918	8	·569	3	·223
4	·944	9	·595	4	·249
5	·970	1·0220	5·621	5	·275
6	·996	1	·647	6	·301
7	5·022	2	·673	7	·327
8	·048	3	·699	8	·354
9	·074	4	·725	9	·380
				1·0250	6·406

TABLE III.

Giving the specific gravity of sugar solution for every per cent. by weight in volume, from 5 *to* 35 *per cent. at a temperature of* 17·5 C.

Percentage.	Specific gravity.	Percentage.	Specific gravity.	Percentage.	Specific gravity.
5	1·0196	16	1·0617	27	1·1033
6	1·0235	17	1·0655	28	1·1071
7	1·0274	18	1·0693	29	1·1108
8	1·0313	19	1·0731	30	1·1146
9	1·0351	20	1·0769	31	1·1183
10	1·0389	21	1·0807	32	1·1221
11	1·0427	22	1·0845	33	1·1258
12	1·0465	23	1·0883	34	1·1296
13	1·0503	24	1·0921	35	1·1333
14	1·0541	25	1·0958		
15	1·0579	26	1·0996		

TABLE IV.

Formulæ for the conversion into each other of current measures of heat, capacity, and weight.

To convert degrees Celsius into degrees Fahrenheit :—Multiply the degrees Celsius by 18, divide by 10, and add 32 to the product.

$$\frac{C^\circ \times 18}{10} + 32 = F^\circ.$$

To convert degrees Fahrenheit into degrees Celsius :—From the degrees Fahrenheit subtract 32, multiply the residue by 10, and divide by 18.

$$\frac{(F^\circ - 32) \times 10}{18} = C^\circ.$$

1 kilogramme = 1000 grammes = 15432·3488 grains.
1 gramme = 15·4323488 grains.
1 hectolitre = 100 litres = 176·17 pints or 22·0212 gallons.
1 litre = 1000 cubic centimetres = 1·7617 pints, or 0·220212 gallons, or 35·234 fluid ounces.

1 grain = 0·064857 grammes.
1 gallon = 4·54107 litres.
1 pint = 0·5676335 litres.
1 fluid ounce = 28·3816 cubic centimetres.

1 litre = 1 kilogramme water at 4° C in vacuo.
1 gallon = 70,000 grains water at 16·66° C in air at 30 inches barometer.

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B.

C.

THE END.

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