Laborers distributing insects in a Calimyrna fig grove for the caprification of the fruit. Explained in Chapter II.

FIG CULTURE

BY

A. C. VAN VELZER

BEING A STATEMENT OF THE HISTORY VARIETIES AND BOTANY OF THE FIG, IN ASIA, AFRICA AND AMERICA, AND A SPECIAL TREATISE ON ITS PROPAGATION, CULTIVATION AND CURING IN NORTH AMERICA

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TO MY BELOVED WIFE:

WHOSE LITERARY TASTE AND ABIDING INTEREST IN THESE AFFAIRS HAS BEEN MY GREATEST AID, THIS LITTLE VOLUME IS AFFECTIONATELY DEDICATED.

THE AUTHOR.

PREFACE

This volume is not intended to be a treatise upon the philosophy of tree growth, but rather an every-day guide for the beginner in fig culture, and a field manual for the experienced grower. Abstract discussions of soils, plant food, available fertility and the creation of wood and fruit are, therefore, avoided so far as possible, notwithstanding such subjects form the basis of accurate knowledge about every operation of farming.

For collateral reading see bulletins 5 and 6, bureau of plant industry, bulletin 1, division of pomology, bulletin 20, division of entomology, farmers' bulletin 342, yearbook for 1900 of the Department of Agriculture; bulletin 61 of the Georgia station, bulletin 112 of the Alabama station, bulletin 184 of the North Carolina station, bulletin 90 of the Louisiana station, and bulletin 62 of the Texas station; a monograph by Roeding, of Fresno, California; Horticultural Transactions IV, 20; San Francisco Rural Press, issues of February 20, 1892, May 18, 1895, and November 2, 1901; "Guide to Fig Culture," Benson; "The Caprification or the Setting of the Fruit," Lelong, 1891; Placer County Republican, Auburn, California, issue of December 29, 1886; "Fig Industry in Florida," Reed; "Caprification," Riley, 1895; "Description of Fig Insects," Saunders, 1883; "The Diocism of the Fig in its Bearing on Caprification," Swingle, 1899; U. S. Consular Reports, 1882, No. 15; 1888, No. 88; 1884. Nos. 41½ and 44; "Culture of Fig Trees in the Open Air." Wickham, 1818; Transactions of the Entomological Society, London, 1847, Vol. IV, page 260, and 1882 and 1883; U. S. Department of Agriculture. Special Report No. 4, "Cultivation of the Fig." These deal with the special subject of "figs." The following publications give many interesting scattered facts, though devoted mainly to other inquiries: "Journal of a Political Mission to Afghanistan," Bellew, 1862; "Our Common Fruits," Bernard, 1866; "Forest Flora of North-west and Central India," Brandis, 1874; "A View of the Cultivation of Fruit Trees," Coxe, 1817; "Notes and Observations on Ionian Islands and Malta," Davy, 1842; "Mission to Yarkland," Forsyth, 1875; Gardeners' Chronicle, London; "History of the Discovery and Conquest of the Canary Islands," Glas, 1864; "A History of Plants," Hill, 1751; "The Country of Beloochistan," Hughes, 1877; Journal of Royal Horticultural Society, Volume III, 1846; Report for 1889 of Board of Horticulture, State of California; Botanical Dictionary, Milne, 1770; Encyclopedia of Horticulture, Bailey; "Select Extra Tropical Plants," Mueller, 1888; "Journey Through Arabia," Palgrave, 1865; "Companion for the Orchard," Phillips, 1831; "Travels in Barbara and Levant," Shaw, 1757; "Tropical

Agriculture," Simmons, 1889; "Hand Book of Fruit Culture under Glass," Thomson; "Travels to the City of the Caliphs," Wellsted, 1840, Volume II; "California Fruits and How to Grow Them," Wickson, 1889. The foregoing are printed in the English language; publications in foreign languages are somewhat more numerous, and include such ancient classics as Plinius, Lib. XV, Cap. 19; Aristotle, "Historia Animalium," Lib. 5, Cap. XVI, 3; Cato, Scri. Rei Rustici, Vol. 1, page 19, Cap. 8, 1; Theophrastus, C. pl. iii, 6, v. 2; and Varro, Script. Rei Rustici, Vol. 1, page 268, Lib. ii, Cap. XI, 5.

INTRODUCTION

The following pages are little more than a chronicle of field investigations and personal experiences of the writer, to which are added a few observations upon the work of other fig growers and a short historical statement. The effort to obtain definite knowledge of this special subject led to the discovery some years ago that an entire lack of harmony of methods existed among growers, the processes of preservers were without uniformity, while informed persons usually withheld information which they considered business secrets. Investigations were also hindered by a conspicuous lack of recent literature upon the subject, while growers, themselves, had not written of their work, and the few bulletins in print at experiment stations were topical essays and reports rather than detailed discussions. Gustave Eisen's careful statement of the history, botany, tillage, classification, diseases and curing of figs, published in 1901 as a circular of the Department of Agriculture, is valuable as a condensed scientific treatise.

The facts sought by growers are sometimes concealed as a result of the unjust methods of many current writers, for exaggerated reports of crops, markets and profits not only prepare the public to believe glowing misrepresentations, but such is the effect of prevalent opinions upon the minds of average men, that growers are more or less unfitted for making impartial statements about the history of each orchard. The field is not yet cleared of the litter of exaggeration, not to mention the baseless descriptions of promoters. The industry will not recover from these injuries until there is a spread of general knowledge and public opinion is created that will forestall imposition. There are many intellectually honest farmers in every community from whom the truth can be learned about their work and profits, and when this class shall have learned definitely the merits as well as the obstacles to be overcome by mastering the details of fig raising on a commercial scale, the day of impostors will have passed. When the culture is placed fairly upon merit alone it will stand far more securely with the people than it now does, success then depending upon the application of simple processes of intelligent horticulture.

The writer has undertaken to study a number of fig orchards at first hand, and by keeping a record of each for a number of years, to ascertain the results of cultivation, mulching, fertilization, irrigation, drainage and pruning, to observe the effects of windbreaks and drouths and conditions which produced or modified freezes and frosts. These personal remarks are merely reminiscent, and simply suggest the necessary course to others who may wish knowledge of the subject from actual work in the field. It has extended over several years, and from a remarkably large number of apparently conflicting conclusions during the early part of that period definite general opinions have gradually dawned, and as these have become fixed by subsequent data the work has simplified and methods made clear. Many experiments remain incomplete, for the great cost of tillage should be materially reduced without impairing its effectiveness, and there is much uncertainty concerning several elementary field operations, as well as the treatment trees should receive under special conditions. In all cases the aim has been to depart as little as possible from practices which accord with established rules of botany and pomology, and to use constant caution when proceeding contrary to the elemental teachings of plant feeding and growth.

While theories of scientific horticulture sometimes come forcibly into discomfiting collision with stubborn facts in a way that makes academic pomology appear ridiculous, such conflicts are more apparent than real, and can always be reconciled by further search for causes. Those who point to errors of this kind should remember that science is merely "classified knowledge," that if facts about soil, trees, fruit and climate are really understood, their classification in logical order, or scientific arrangement, will merely give them clearness, force and educational value. Science has never added a single truth to those of Nature, but teaches orderly mental processes, which greatly aid in searches for light.

A recent apparent conflict of academic knowledge with field practice will illustrate: Soils from worn out potato fields examined in the laboratory were found to contain abundant food of all forms necessary to grow potatoes. There was sufficient matter therein, both organic and inorganic, to supply usual quantities for normal growth, but notwithstanding good tilth was maintained, the fields failed to produce crops. This was an opportunity to decry that science was wrong in determining that such plant food existed in the soil at all; but when the chemists looked further it was found the excreta from potato vines was toxic, and finally accumulated in the soil sufficiently to poison the roots; that the ground required renovation by the growth of other vegetation, or recuperation by summer fallowing.

Whether applied to tillage of fig trees or to other horticultural lines, a knowledge of plant nutrition, soil chemistry, wood and fruit formation, and diseases of trees, called scientific agriculture, forms only a basis of information for field work. Even the broadest knowledge of statistics about farm practices will often mislead, unless applied with discriminating care, following faithfully our primary rules of botany, physics and chemistry. There was an occasion, recently, to investigate the use of field peas for soil renovation, and from considerable information gathered, the following quotations illustrate how unsafe it is to rely solely upon reports of academic writers, and show how easily one may be misled by advice upon particular problems, even when it comes from men of unquestioned capacity, whose lives have been devoted as educators in seeking truths about agricultural work.

Speaking of field peas:

"Nebraska is too far south for the best results with this crop." Neb. Bull. 84.

"This crop is one of the most serviceable in a forage crop rotation, supplying food when other crops are not available." N. J. Bull. 158.

"It does not grow well except on good soil." Penn. Bull. 102.

"Canada peas are perhaps used more than any other legume in the citrus orchards in California. The effect is very satisfactory, so far as improving the tilth of the soil." U. S. Bull. 278.

"Experiments have been made in the Southern States to determine its value as a winter and spring crop. The results so far have shown that it withstands the cold of the Southern winters successfully, and makes a good growth." U. S. Bull. 147.

"Canada field peas are of no value to us. We have never found them to be of any good." Director S. C. Station, Jan. 22, 1909.

"Canada peas have never proven a great success in the South." Pres. Ga. Univ., January 22, 1909.

"An average of all varieties grown during the years 1904 and 1906 show a yield of grain of 39.5 bushels and of straw 2.34 tons per acre." Mont. Bull. 68.

These references, selected from among quite a number, all showing a great dissimilarity of opinions, illustrate the danger of following any one writer, without applying all theories by comparative tests to each particular farm and field to be tilled. Canada peas is commented upon, for something will be said later about its value as an orchard winter legume, and how satisfactorily its manurial returns increase nitrogen and humus in the soil, as well as benefit physical texture. The future course of an inquirer often depends more upon the preferences of the individual consulted than the relative merits of different crops, and in this case a beneficial legume would be discarded, or adopted, as local observations of a writer would suggest, while a green manure that might have just fulfilled his requirements would, perhaps, have been neglected. On the other hand, if the farmer knows what field peas need as to soils and temperature, their effect upon texture in general, and the nature of their deposit of nitrogen in root nodules, then by learning the kind of plant food that should be added to his own soil to keep the orchard in health and vigor, the opinions of others will afford valuable collateral information which he can readily apply to individual operations.

No pomologist is safe in giving didactic instructions about the tillage of fields with which he is not personally familiar. The only value an opinion ever has is its reason, and in horticulture it is impossible to attach much weight to long distance advice based upon hearsay statements. The farmer is inevitably left to solve his own problems with such aid as comparative studies may give. Fortunate is he who possesses a practical acquaintance with botany, physics, chemistry, climatology and entomology, for, as these sciences are the main sources of an accurate knowledge of agriculture, education in them will greatly aid in simplifying the problems that occur every day upon the farm.

We have read many beautiful passages in pomological literature about the evolution of plants, and how each variety, as a rule, improves itself in time by going through cycles of progressive development. The books are so well stocked with attractive descriptions of evolution that it seems vulgar to suggest heresy to those poetic conceptions; yet when considered from the view point of the weaker plants such poetry is but meaningless words which, by their artful impressions, elevate the mind above the real, vital life and death struggle for plain existence that is going on next the earth, where the strong proudly lift their heads for a brief space over the bodies of weaker ones which they have choked and smothered to death. Life is common, plain and natural, and it will assist every one to a proper mental balance, and a sane poise of mind, to study next the earth rather than by the construction of poetical scintillations about commonplace, everyday vulgarities.

Not long ago a frog hunt was undertaken. By the flaring torch light a few fish were caught, moccasins killed and great bullfrogs speared. In the bellies of each there were lesser and weaker animals which had lived at the same creek. The fish had caught little snakes, the snakes eaten frogs, the frogs devoured crawfish, and they had swallowed insects. Beautiful evolution! but so severe upon the weaker animals!

So with plant life. Each one thrives by killing, and then absorbing those around it. The weak are suffocated and soon enrich the soil that the strong may grow. Then the strong succumb to conditions that are inevitable, and make food for the next generation. Thus the depth of soil is increased and subsequent vegetation grows larger. It is progress, development, evolution; but those who keep an ear close to the ground can almost hear its plants ever in common, vulgar strife, essentially like the reptiles of the swamp and beasts of the jungle, the weak creatures of each generation being ruthlessly devoured and contributing by their death to the growth and power of heartier neighbors.

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CHAPTER I.

THE FIG.

The English "fig" has both a Latin (ficus) and a Hebrew (feg) origin. From the beginning of tradition it was a household tree, being described in the earliest writings of every religion, and the first chapters of authentic chronicles. The fig finds place in the oldest European literature, the Homeric songs, and the ancient Greeks not only relied on this fruit as a staple crop, but minutely described the varieties then cultivated, writing volumes about its tillage, and an epidemic among the trees was considered a public calamity. They called a city Sikyon, after the Greek word syke, meaning fig, and attributed the origin of the trees to the thoughtfulness of the goddess Ceres, who, through affection for the people, caused one to grow at Phykalos. Before acquiring its present meaning, the word "sycophants" was applied to all Athenians, and meant "fig eaters."

The fig matures from a collection of flowers enclosed by a protecting shell, and is placed in the same family with the mulberry. The little flowers open inside the shell, which at first is tough and woody, and they swell with the gradual accumulation of sap and starch, in time changing to juice and sugar, ripening into palatable fruit. The gradual development of the fig is an interesting lesson in plant evolution. At one time, certainly, there were no edible figs, and wild varieties which still grow in great numbers along the Eastern Mediterranean indicate that centuries of intelligent plant breeding produced trees bearing palatable fruit before the recorded history of Europe began. Those trees whose flowers mature in woody knots, or warty shells, instead of edible fruit, are called capri figs. The abstract question whether the fig is a fruit, or not, has been gravely discussed by medieval writers, but that is a matter of scientific differentiation; as it has palatable pulp and juice which remind us in the eating more of fruits than of nuts, or of any other food, for household and commercial purposes it will continue to be accepted as such.

It would be interesting to sketch the growth of the area of fig cultivation, but that would be beyond the object of this volume. Our best information is, that the edible varieties were flourishing in Asia Minor at least nine centuries B. C., and from that period on with each martial conquest the invading armies carried them along, and spread one variety after another, until the Mediterranean countries, Portugal, Southern England, Central Asia and Eastern Africa were well stocked; while the attention they received by such historians and naturalists as Varro, Pliny, Cato and Virgil attest the great importance the ancients attached to them as a staple article of food. We remember reading how Romulus, the founder of Rome, suckled a she-wolf under a certain fig tree, which tree was supposed to have lived until long after the rulers of that country emerged from their mythological character; we have also read that the prophet Mohammed exclaimed over his desire to take figs, of all fruit, with him to Paradise.

At times the figs of Portugal and Italy have rivaled those from the Meander Valley, even to the extent of monopolizing the European markets; but the Smyrna fig, as grown and packed at its ancient home, has successfully overcome competition with its western rivals, until now it has driven every other variety from all but local fields, being well established as the standard dried fig of the world. It remains to be seen what will result from the recently developed Calimyrna, or Cali(fornia-S)myrna fig, when that important fruit is raised in sufficient quantity to come into open competition with Asiatic exportations in the large markets of the world.

CHAPTER II.

THE FIG IN CALIFORNIA.

A separate volume could be written about the interesting history of fig culture in California. It is only within the scope of this work to state briefly the main features of its present condition, and give a few illustrations of the difficulties that have been solved by those tireless, capable pomologists who have devoted so many years to the selection of varieties and the perfection of their work. No more graphic nor picturesque recital exists in the history of horticulture than is found in the statement of bare facts about the evolution of fig raising on the Pacific Coast. An enthusiastic naturalist will journey for days, and hunt the wild forests many miles in search of a new specimen to place in his collection; and when found he will toil over mountains, swim rivers, face storms, and consider himself fortunate if he arrives safely home at last with his discovery uninjured. But those few men of California who have been pioneers in fig growing have traveled continents, crossed and re-crossed oceans, established residences in the Orient, and expended fortunes in an effort to develop the finest fig in the world acclimated and accustomed to its new western home.

California figs are easily divided into the domes-

The Mission Fig Tree of California. This variety was introduced by Spanish missionaries, and is extensively cultivated on the Pacific Coast as far south as Chile.

tic and the commercial varieties. Of the former the Mission, imported from Spain, through Mexico, is best known. The fruit is large and black; the trees often grow twenty feet high, with about the same spread. The fruit is juicy and fairly sweet, and, having been introduced with the Spanish Missions, is found from Napa, California, all the way down through Central America to Southern Chili. Other dooryard varieties are the Brown Turkey, Ischia, Lugonia, Cernica, Brunswick and Genoa. The Adriatic, first grown in Calaveras County, has, until recently, been the commercial fig of the coast. It is of medium size, fairly sweet, pyriform, thin, light green skin, yellowish red pulp, and open eyed. It requires a dry climate for profitable raising, as humidity causes souring quickly, and, away from the foot hills, has never been a success. When dried it is smaller, darker and much less sweet than the third grade of imported Smyrnas, and has never brought more than about five cents a pound retail, this price being equivalent to less than one cent a pound to the grower while the fruit is fresh. These facts explain why its place in the market is being rapidly taken by the acclimated, high bred Smyrna, called Calimyrna, in honor of its new home.

In 1880 G. B. Rixford made the first importation of Smyrna cuttings to San Francisco, and two years later he received a second consignment of fourteen thousand. During the latter year F. Roeding maintained an assistant in the Meander Valley for the further study of the habits of the tree, and from him received cuttings of several varieties. In 1885 Mr. Rixford imported a large quantity of cuttings, which were distributed among the rural subscribers to the San Francisco Bulletin, Governor Leland Stanford financing these importations. John Rock obtained more cuttings in 1891 which he planted at Niles. From these numerous large Smyrna fig trees grew in widely scattered localities, but the fruit invariably fell off before maturing. Although the trees were tried in various soils, altitudes and temperatures, no ripe fruit was obtainable. By the combined efforts of missionaries in the Meander Valley and the pomologists sent there by the United States Department of Agriculture, together with experiments conducted by Californians at home and in Smyrna, it was discovered that these varieties required trees in each orchard which contained flowers of both sexes, as well as gall flowers, and also needed a waspish Asiatic pollenating insect, called *blastophaga grossorum*, to fertilize each green fig, in order to grow; otherwise the fruit dropped. Even after these discoveries Californians spent fifteen years in learning to import the insects without their deterioration while traveling, in providing a home within which they would lay eggs that would hatch, and in acclimating them.

The intricate problem of caprification concerns Smyrna figs alone. There are more than thirty va-

Adult Male—*blastophaga grossorum* (Enlarged).

Adult Female—*blastophaga grossorum* (Enlarged).

This insect gets pollen over its body while struggling to get out of male fig flowers, and in hunting for a nesting place she spreads the pollen by going in and out of the female figs.

rieties grown in the Meander Valley of Asia Minor, all of which require pollenation. The process is based upon the fact that the female flowers inside the edible figs, which are open at the eye like a shell, when green, require contact with pollen from male flowers in order to mature. In Asia Minor natives bring the wasps to their cultivated orchards in the low lands by cutting off limbs from wild fig trees, which grow abundantly in the hills, and as the wild trees are permanent homes for blastophagæ the branches removed contain insects which soon emerge from the green fruit, and then travel so incessantly on cultivated trees where they are placed, constantly entering and emerging from the green edible figs, that the pollen is distributed from their legs and wings over the innumerable female flowers inside of each shell, and furnish fertility necessary for the growth and maturity of the fruit. The activity of the wasps is due to their search for places to lay eggs.

There are now more than four hundred acres in California bearing profitable Smyrna figs. Although still in its infancy, the industry will in time grow to be an important one—judging from the yields per acre and the readiness with which dried fruit is sold at good prices. The few packages that reach the Central States have fine flavor, and in appearance they are superior to any Smyrnas sold in this country. Calimyrna cultivation will, doubtless, be confined to the inland counties of California, on ac-

A Fig Orchard at Fresno, California.

count of the necessity for arid conditions during the fruiting and drying season. In moist localities the fruit must be cured in evaporators. But the San Joaquin Valley from Stockton for three hundred miles south, as well as the interior north and northeast from Los Angeles, where frosts are not too severe, afford attractive areas for this culture. The sensitiveness of blastophagæ to cold, perishing in a hard frost, has led to their protection in elaborate and expensive winter quarters, where they are thoroughly sheltered from the weather.

The ease with which Calimyrna figs are dried, and the demand for them in their home State, has caused the crops to be cured in that form, rather than used for preserves. It may be that in the coastal districts where humidity prevents successful out-of-door drying, they will be utilized as preserves; no objection can be foreseen, and it would afford an opportunity to considerably enlarge the area of their production in commercial quantities. The size and superior sweetness of the Calimyrna over every other variety suggest distinct advantages; and it is difficult to find any reason why they are not adapted not only to every purpose for which other varieties are now grown, but also to many uses which Adriatics are not suitable for.

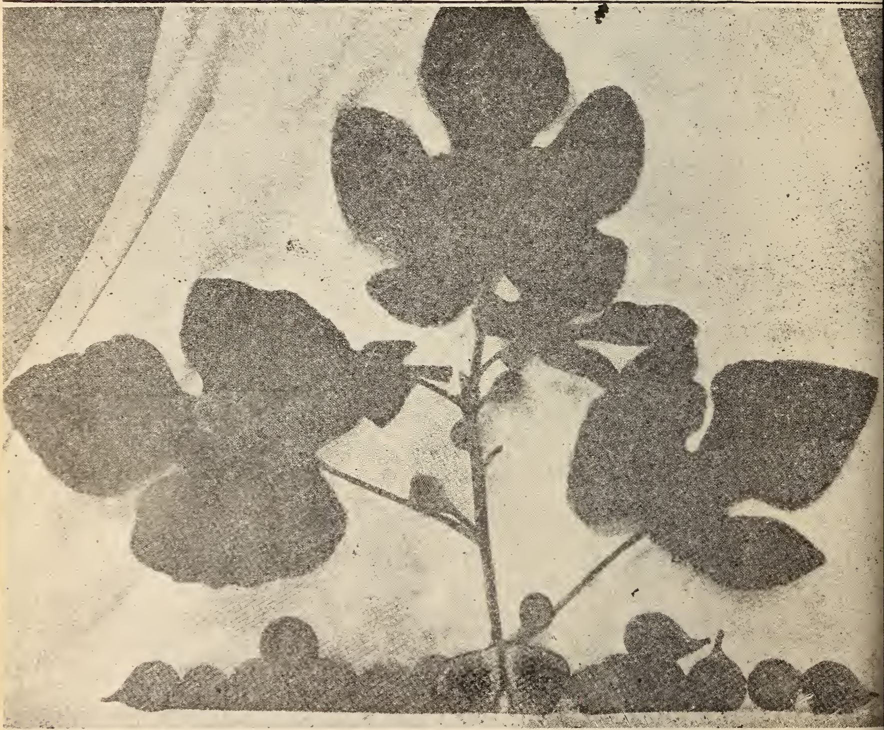
There is a plant in Los Angeles, and a few small concerns at other places in the State, which preserve figs, these being put up without attempting any uniform results. Some make a spiced article, similar to sweet pickles; others use a heavy syrup in "pound for pound" preserves, while still others produce goods which vary according to standards of their own. The largest quantities are shipped in gallon tins in very light syrup, and when reaching the eastern markets are repacked in the glass of distributing concerns. As a rule, the fruit is cooked to pieces, which allows the seeds to escape into the syrup, thus injuring the appearance of the final package. Packing in gallon tins is done by cooking just as little as is possible in a very light syrup. The Eastern distributers prefer to buy goods which contain no sugar at all, but such can hardly be obtained. When thus processed, the original shape of the fruit is unimpaired, and in the artful hands of the repacker it is finally attractively displayed in convex glass.

CHAPTER III.

THE FIG IN THE SOUTH.

Throughout the South the fig is extensively raised as a yard tree. Commercial growing has been tried during the past ten years with varying success, but it is still in an experimental condition. The varieties in domestic orchards are usually the Celeste, Magnolia, New French, Lemon and Brown Turkey. There are others, such as the Marseilles, Ischia, Mission and Petaleuse, but their number is inconsequential. The bulletins of the Louisiana State University describe more than thirty varieties growing in its experimental park. All the figs raised in the South are called Asiatic, to distinguish them from Smyrna and Capri figs, but this classification should not confuse them with the so-called Adriatic fig, a distinct variety well known to California commerce. The Celeste is probably grown more for household uses than all others. The fruit is small and yellow, being sometimes called a "date fig." The skin is so thin as not to interfere with eating when cooked, and it makes delicious marmalade.

"Of all the varieties grown in Louisiana, the Celeste is the hardiest, most prolific and most popular. Its one fault is its small size. There are a number of varieties that should be grown for preserving purposes. Among these should be mentioned the

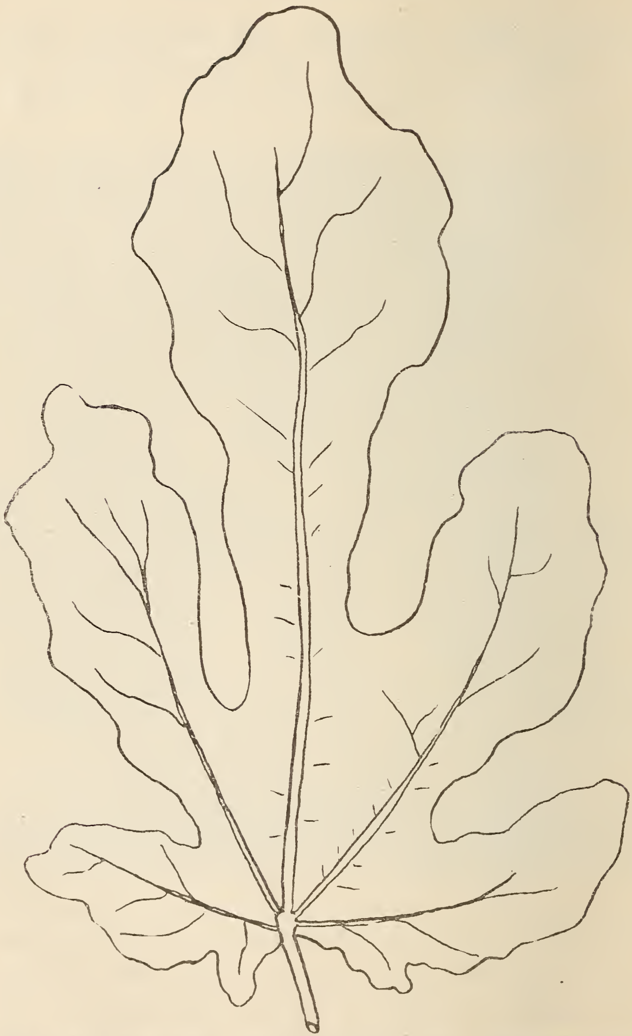


A favorite fig in the Gulf States; popular for its juiciness and flavor.

Monica Bianca, Madeline, and Brunswick, while the Mission is very sweet, and answers both the purposes of table and preserving fig.'' (La. Orchard Report.)

For commercial uses the Magnolia has steadily supplanted other trees, and will probably increase in favor as it becomes better known, and as methods of tillage continue to be improved and simplified. ''Figs constitute the main fruit crop of Louisiana. They are perfectly at home in nearly every section, and grow and produce abundant crops without any care or attention. In the event of the extension of the canning industry, fig growing may become of great commercial importance. Being soft, not being able to stand transportation, and not being suitable for commercial drying in this climate, commercial fig growing will depend upon the cannery for development.''

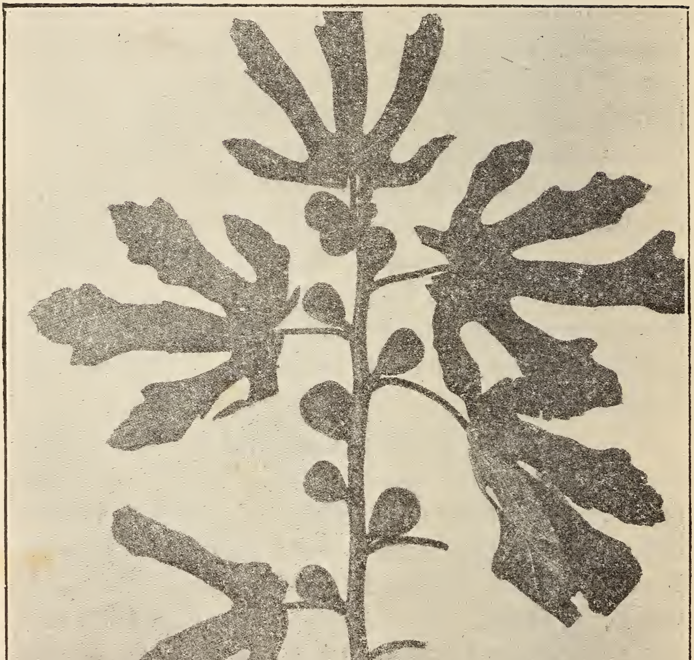
The use of fresh figs is confined almost entirely to each locality where the fruit is raised. With the exception of the New French, all Adriatic varieties open the eye upon ripening, and thus afford entrance to acetic bacteria, fermentation fungoid, vinegar flies and insects which quickly impair the texture of cells containing fruit syrup, and souring follows in a few hours. The New French is somewhat more resistant to these troubles, but its keeping quality is inferior to that of ripe grapes or ripe strawberries. Shipments have been successfully



Leaf of the Brunswick, or Magnolia Fig. The most extensively raised fig in the South.

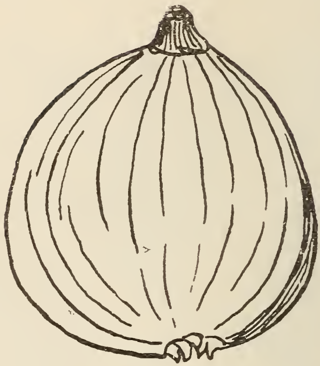
made a distance of fifteen hundred miles, but under unusual conditions for gathering the fruit and in transportation that could not be depended upon as a commercial rule. While the taste for fresh figs is acquired, that for preserves is natural. When thoroughly ripe it has a laxative effect so well recognized that at least two brands of patent medicine in large use employ the term in their labels and advertisements. This effect is carried into the preserved article, and in that state the fruit is not only palatable, but has medicinal value so well recognized as to be prescribed for very young infants whose digestion has been impaired. However, in this connection, it must be said there is an occasional person to whom the seeds act as an irritant in the stomach.

It is impossible to make a general statement that would give proper methods of growing yard fig trees, for conditions are so different as to soil, water. exposure and temperature that beneficial treatment for one might be injurious to others even a few feet or a block away. For instance, a tree with roots under a house, or covered with wood, or litter, needs little attention, while those exposed to the sun in a grass sod will easily suffer if not carefully tilled. The writer has seen fruit gathered every day during July, August and September from a single large Celeste tree on a town lot, the continuous crop resulting from care in stirring the soil and an adequate water supply. In the case in mind water was used

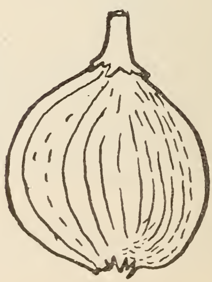


Top Branch of a Brunswick Fig Tree, showing how fruit sets at the axil of each leaf on new wood, instead of on year-old fruit spurs.

every night during dry weather in a very small stream from a garden hose, and the ground was of such nature that there was no "water logging" nor accumulation in the subsoil. Such practice is not recommended except in occasional cases, when conditions permit, but from a conservative estimate not less than four bushels of ripe fruit was gathered in one season from this single tree. On the other hand, without moisture they invariably drop both fruit and leaves during long drouths, and then make new growth when sufficient rains follow each dormant period. This feature of maturing fruit and then becoming dormant in the summer has led to a general belief that there is usually but one crop, that some varieties produce two crops, while a few mature a third. Writers constantly maintain that fig trees have periods of fruiting, with intermittent dormant times each season, and they call the first of the season the choicest, or brebas figs. But during the summers of 1906 to 1909 observations in the South at a number of orchards, where adequate soil moisture and good tilth were maintained, determined that crops ripened continuously from the beginning of the season until cool nights interrupted growth, while the quantity of fruit gathered each day varied no more than other orchard trees with the weather. Notwithstanding these opinions it was found that under favorable conditions figs bear uninterruptedy in the South during the months of July, August and September, and until cold



The Brunswick, or Magnolia Fig, as it grows along the Gulf in good soil. (Reduced size.)



Celeste Fig. (Natural size.)

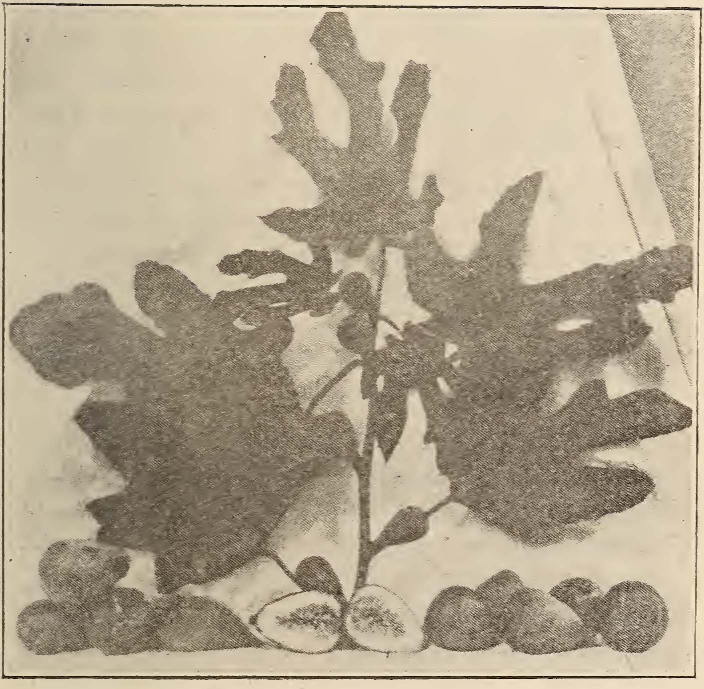
nights in October arrest growth, when immature fruit is always upon the trees.

Commercial fig growing in the South is undoubtedly in its infancy. Some orchards exist in Mississippi near the Gulf, others near New Orleans, a few in the vicinity of Galveston, Beaumont and Houston, and there are small acreages in widely scattered localities. Near each orchard are one or more packeries maintained to preserve the fruit. But the industry has been rather restricted, and is still in an experimental condition. There are very serious problems that must be solved by each grower before any of them can establish their enterprises upon a commercial footing, and few are willing to patiently lay a foundation for solid and lasting success. Then, too, a great many press items have done fig culture inestimable injury by exaggerated reports, which encourage men of inadequate means, and without experience, to undertake the work, though seldom conceiving its serious nature, the difficulties to be overcome and the care and attention demanded. Undoubtedly, for a man of industry and knowledge, it is a profitable branch of farming, but unless development companies let it stand on merit and state facts about the trees, the soil, the harvest, the preserving and the markets, surprise and discouragement will come to growers, and many of them will continue to abandon orchards, hastening into other occupations, and the culture will be further condemned in its entirety, prospective investors thereby becoming unnecessarily alarmed. No agricultural development ever made much progress until the difficulties, as well as the profits. were equally considered, and seriously anticipated; for only by so doing are investors enabled to act intelligently with that commendable circumspection which forstalls disaster; and, aside from all moral considerations, the industry is injured by enticing uninformed strangers thereto. Such development stimulates merely an abnormal growth; for real, lasting progress cannot be expected otherwise than by placing the enterprise solely upon its inherent excellence.

The following illustration is quoted from a monthly farm journal: "It is estimated that a bearing fig tree will average six bushels to the tree. Figs are planted 150 trees to the acre, which gives 900 bushels of figs to the acre. Figured at 75 pounds to the bushel, this would make 67,500 pounds of preserves, which, sold at 10 cents a pound, would yield $6,750. Subtracting from this for sugar and labor, on the basis reckoned in the fig preserving plants, leaves a net figure of $1,687.50 for the yield of one acre of figs." The above, printed under the name of a contributor of local prominence, who is usually considered a careful and prudent man, was published in a journal which is creditable and representative of its class. That it was ever written or published at all—and it is only one such statement among thousands—but illustrates the great lack of knowledge of fig culture, not only by the reading public but by writers as well, for we cannot believe responsible contributors wilfully misstate facts. One bushel a tree is a good crop; two bushels is extraordinary, and, when picked for preserving, weigh from forty to forty-eight pounds—not seventy-five. It would require quite an extended statement to correct the errors in this quotation alone.

There has never been a successful effort to acclimate the Smyrna fig in the South: it is now being attempted in Louisiana for the first time. Several small shipments of nursery stock have been made to Georgia, Florida and Texas; and many trees locally believed to be of that variety are not so. No caprification has been successful, and it is doubted if the blastophagæ could survive our sudden changes of winter weather without being housed in very expensive quarters. It is not questioned that Smyrna figs, of as good size and quality as are grown elsewhere, can be raised in the South, but until some enthusiast with adequate capital undertakes the work in a systematic way, following recent experiments at other places, the matter will remain problematical. The Smyrna fig is most valuable when dried, and has a ready market, but the Gulf country is too humid for open air curing, and it would add so large an item of cost to process the fruit in evaporators that successful competition with California and foreign products would be conjectural. Except in local markets, it would not be a dependable crop in the fresh state. One of the best known fig raisers says: "During the hot season, when it attains its greatest perfection, it will stand for only a few hours, then becoming sour and worthless. If gathered green enough to stand shipping it will never ripen up with its natural flavor." For these, as well as for other persuasive reasons, the fig growers have omitted the Smyrna, in the South, choosing, instead, that hardy, prolific and reliable variety known in Texas and Louisiana as the Magnolia, or Brunswick.

The Brunswick has many pet names, among which are Magnolia, Red, Large White Turkey, Boughton, De St. Jean, Clementine, Bayswater, Hanover and Madonna. It is pyriform with swollen cheeks, rather unsymmetrical, short neck, distinct ribs, open eye with dark iris, greenish yellow to pale amber when ripened in the shade, otherwise dark violet shading to red. The place it now occupies as the commercial fig of the South is due to large size, abundant juice and the fleshy envelope of fruit pulp just under the skin which allows of preserving without cooking to pieces. Even after the skin is removed it holds a natural shape during canning better than any other variety. The sugar content is about average, the per cent not being as high as that of the Smyrna and the Celeste. The tree naturally takes the habit of a large bush in this locality, and by pruning can be trained to a single.



The bi-sected Brunswick Fig shows the meaty pulp which maintains the natural shape of the fruit in cooking, instead of cooking to pieces.

a double or a multiple standard without affecting the strength of its growth. Those who still contend that the Magnolia is a new variety, distinct from the Brunswick, can discover their error by studying the leaves, bark, wood and fruit, which have characteristics and habits that distinguish it from all others. Some nurserymen profit from this misconception by buying cuttings of Brunswick trees at a much lower price than is asked for Magnolia wood, and they are all sold afterwards as the same stock. It is true, however, that in Florida and South Carolina the stock known commercially as the Brunswick can be distinguished from the Magnolia, but space will not permit us to enter into a discussion of the facts of climate, soil, origin and cultural methods which have developed the difference.

"The growing of figs for preserving purposes has been on the increase during the last decade. Where canneries are located the fig industry should be permanent and prosperous. Near New Orleans figs are in demand for this purpose, as a large cannery located there takes all the figs obtainable. The product finds a ready sale. The demand exceeds the supply, and the grower receives good prices." (La. Bull., 112.) "At Baton Rouge and New Orleans the fig is perfectly at home, growing large crops annually. At the latter place large quantities are canned yearly, and fig orchards near the canneries are very profitable." (La. Bull., 52.)

Various attempts have been made to transport figs from the country to canneries located in cities, but results have been disappointing. The fruit is so perishable that it is invariably impaired in shape and quality. One of the best equipped canneries in the South, especially designed for preserving figs, was dismantled after the first season in a city, and has since been used for a warehouse, while all the costly machinery has gone to the country distributed among small canneries located near orchards. In order to transport to a distance the fruit must be picked too green to have flavor, and the final product is not only inferior, but more expensive, requiring a larger amount of sugar. While ripening Magnolia figs more than double in size during the last two or three days; for shipping they are picked so green as to weigh only forty pounds per bushel; if allowed to remain upon the trees another day their weight is increased eight pounds a bushel; if not picked until thoroughly ripe they weigh about sixty-two pounds a bushel. This rapid growth is caused by the accumulation of juice in the fruit, so that not only is it heavier than when green, but each fig is larger. Therefore, the gain is four-fold: the size of each fig is greater, the cells become filled with natural syrup, the proportion of sugar is increased and flavor is improved; it is difficult to find any mechanical process which will make such rapid gain in size, weight, quality and flavor. These considerations so com-

This fruit is not only juicy, but has sufficient body to make it an all-around, serviceable variety, very popular in the Gulf States.

mend themselves commercially that preservers should assume the increased cost of labor in handling the fruit near orchards, where it can be used ripe, rather than in cities at considerable distances from the harvest field. Of course, when marmelades and crushed fig products are made, the reasons for shortening the haul do not apply with the same force, for then the only material danger is from souring; but, if a first-class article of preserved whole fruit is attempted, the figs must be cooked before they reach such a state of ripeness, or mutilation, as to go to pieces when heated. Transportation is as important to the grower as it is to the packer. He must gather his crop in such state of maturity as the packer directs, and if the cannery is close by he can allow the fruit to add ten pounds to the weight of each bushel by hanging longer on the trees, and still deliver it fresh and unmutilated. It will increase his income thirty cents a bushel, or forty dollars an acre. The facts argue so well for small canneries scattered among orchards at no great distances apart, that, when it is considered at what moderate cost an adequate preserving plant may be equipped, it becomes practicable not only for canning establishments, but also for individual farmers with four acres, or more, of bearing commercial trees, to have plants of their own, and by observing such rules as may be required by dealers and consumers, for uniform consistency and flavor of syrups, either for each grower to pack his own goods, or for a cannery to be maintained in each neighborhood, thus greatly lessening the loss of raw material and improving its quality from natural causes, while the independence of the producers will thereby be greatly aided. The commercial value of fig preserves must finally rest quite as much upon flavor as upon appearance, and when the fruit is picked green enough to stand transportation from orchards to canneries in cities, and still maintain its natural shape, while cooking, the quality is impaired and the quantity greatly reduced. Whenever quality is not up to the same standard found in home-made preserves people familiar with fig flavor will be disappointed and the demand will be injured; but fruit ripened on the trees has characteristic flavor in the final product and is the agreeable and healthful article all canners should attempt to produce. The best flavor cannot be found in fruit picked green, and it is therefore of primary importance to lessen the distance between the trees and the cannery so far as is reasonably possible.

CHAPTER IV.

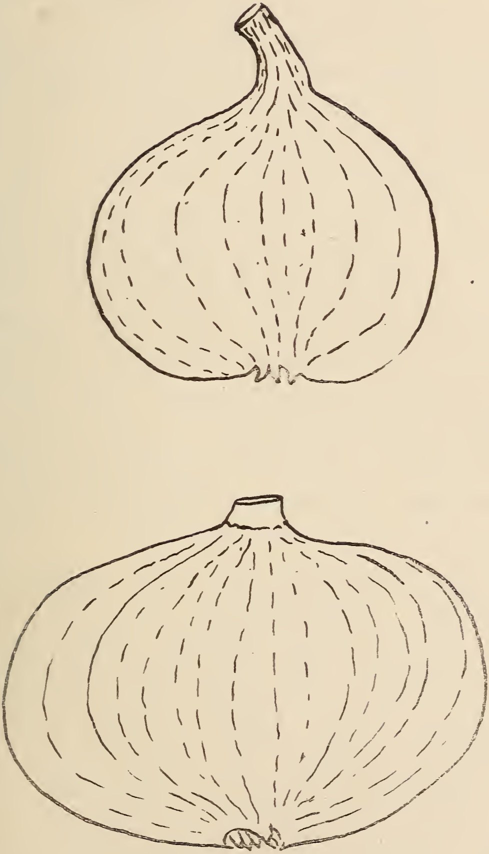
THE FIG IN ASIA.

The figs of Asia exported from Smyrna to almost every city and hamlet in the Western world have so familiarized us with the product that it is a household word. Notwithstanding this industry the prosperity of Smyrna is due more to its trade in raisins and olives. About thirty varieties are grown within one hundred miles of that town, all called Smyrnas. Lob Ingir (juicy fig) is the choicest.

The Meander Valley, lying about eighty miles south of Smyrna, is the principal location of this culture. The fruit is packed and exported from Smyrna, its familiar name coming from trade labels. The valley has a drier climate than the town of Smyrna, elevated two to six hundred feet above sea level, is about fifty miles long and five wide, and protected on the north by the Salatin Mountains. During the last decade the cultivated area has widened into the foothills, and has reached ancient Ephesus on the north.

Although located in the same latitude as Wichita, Pueblo, San Francisco, Shanghai and Kabul, the temperature of the Meander Valley is modified by the Mediterranean Sea and the Salatin Mountains, the climate being about like that of Central Florida, Southern Texas, Northeastern Mexico, Sonora and Southern California. Greek merchants have directed the curing and packing, more or less, during the last century, and their cleanly methods and attractive goods have resulted in successful competition with foreign fruit whose inherent excellence would justify their control of local markets. The Faro figs, of Portugal, were thus driven from European fields, and that industry declined until it has completely languished: Palermo and Calabrian figs were likewise outclassed; the difficulty those from Kabylia found in bringing good prices resulted more from careless handling after harvest than from lack of merit.

In the Meander Valley, figs are not picked, but drop from the trees on smooth, mellow ground, and either gathered at once, to avoid injury from birds and insects, or allowed to dry for a day or two where they fall. They are then carried to Smyrna in hair baskets, or mats, and sold to merchants. After being sorted into three grades the refuse is put up in fifty-pound bags for coffee adulteration or for distilling. The best grade is called "eleme," or select, the next grade "locoum." Very few eleme reach the United States. "Erbelli" is a special brand of eleme figs, supposed to be choicest, and come from Erbeghli, a small village in the Meander Valley. English shippers have recently invaded this field and by packing under their established



Two varieties of ripe Smyrna Figs.

trade brands grades of fruit can be relied upon to continue uniformly year after year.

Natives plant trees sixty feet apart by digging a good sized hole for each and placing two long cuttings therein, which cross below the ground. The angle of the cuttings is supposed to allow trees to bend when their tops become heavy to avoid breaking. Cuttings are left one bud above the ground level, and the exposed part is then covered with a mound of loose earth to prevent drying by wind and sun. No pruning is done and the "multiple standard" which results allows the greatest freedom of air and sunshine, for, like other fruit, the poorest figs grow in the shade. The fruit is not used for drying until the trees are four or more years of age. Large trees sometimes yield eight bushels each, the average being about six. Their caprification is discussed elsewhere.

In Syria, Phœnicia and Arabia varieties reached a high state of development, and many of them were introduced into Europe during the invasions of Arabs. The Faro fig, of Algarve, was transplanted from Arabia in that way. East of Syria and Arabia, their introduction has been slow, although wild trees are apparently native in India. They are described as flourishing in Chinese gardens the latter part of the sixteenth century, and have since extended over the entire southern part of the "Celestial Empire" and India.

CHAPTER V.

THE FIG IN EUROPE.

Figs are raised in Greece, Italy, Spain, Portugal, France and Southern England. Around Paris forty-nine varieties are known, and more care is given than at any other place. They are buried in winter, maturity is advanced by a drop of oil placed on each eye, leaf buds are carefully selected and systematic pruning continues throughout the growing season. Until recently the figs of Algarve had for centuries supplied all large western markets. Figo da Comadre acquired fame for size, appearance and quality. Careless methods of handling are largely responsible for the loss of that industry, as the half-dried fruit, brought to merchants by uncleanly peasants was dumped upon the ground to drain the juice off to be manufactured into brandy. Then, bruised and injured, it was spread out in the dirt an indefinite time to dry before being packed into unattractive baskets made of leaves. The consumers were thereby prepared to discriminate in favor of Smyrna figs so soon as better methods of curing resulted in attractive and clean fruit and the Portugese product was without a market.

The exportations from Spain to France, Austria, Great Britain and Germany are enormous, being largely utilized in the manufacture of distilled spirits. Burjasot is the most popular variety.

Sicily, Southern Italy and the Liparian Islands form a district where figs are an important crop. The export trade is largely to other parts of Italy. In the extreme south their quality is superior to Smyrnas in sweetness, but inferior in size, color, aroma and texture of skin. They slightly out-rank Smyrnas in albuminoids. The merchants pack them in primitive esparto mats.

In England fig culture is done in pots and greenhouses, but is profitable. Occasionally a tree will thrive close to a high north wall. Soil for pots is made of one-fourth slaked lime and three-fourths loam. Dilute urine is used for fertilizer. The trees are re-potted each fall and kept cool to insure dormancy, but protected from frost during winter. In comfortable temperatures they bear continuously from June until October. Ripe fruit sells at good prices.

Fig culture has a very ancient history in Greece, dating back to the ninth century, B. C. At one time the tree was sacred, like the olive, its origin being attributed to Demeter, who created it in reward for hospitality. Exportations were prohibited, being considered too valuable. It was symbolic of fertility, and fruitfulness, and was used in religious ceremonies. Most of the crop is now made into brandy, its quality being inferior to Smyrnas in every respect. Notwithstanding, 1,500,000 tons are exported annually to central Europe.

CHAPTER VI.

THE FIG IN AFRICA.

Outside of Smyrna the largest fig district in the world is east of Algiers, in Kabylia, where twenty-eight edible varieties are grown; some require caprification. They are dried in the sun and constitute a staple food of the country the year around. Those exported are packed in baskets and jars, with sweet bay leaves to protect them from insects. In quality all are inferior to Smyrnas and are mainly used in Europe in making distilled liquor and for adulterations of coffee. About 800,000 tons reach Europe annually, being the principal crop of the district. The trees grow very large, and high, and are tilled oftener with the spade than with oxen. In winter young limbs are plastered with cow dung to protect from frost, and sinks are made around each tree to collect the scant rainwater. Those who are able plow twice each year, in January and May. The trees are planted forty feet apart. Poor methods of curing and packing result in unattractive fruit.

Egypt is an ancient home of figs, but the industry has never reached important proportions, about 100,000 tons of inferior quality covering the annual export trade.

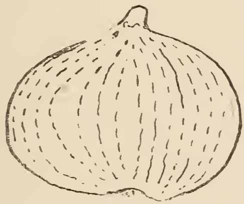
CHAPTER VII.

THE FLOWERS AND FRUIT.

Fig flowers are invariably grown on the inside of woody, shell-like envelopes, all of which softens into fruit. Some trees bear male flowers, others bear both male and female, while the edible Smyrna varieties have only female flowers. The flowers of other edible figs are probably descended from females and are sometimes called mule flowers. Pollenation is necessary with Smyrna and Kabylia varieties, and is accomplished by hatching blastophagæ in male fruit, the insects, while struggling to emerge, becoming covered with pollen, which they carry to female flowers in seeking places to lay eggs. But one kind of wasp has been found adapted to this work, the flowers being so concealed by surrounding fibre that bees and other insects fail to find them.

The smallest figs measure less than an inch in each dimension, and are of the following varieties: Angelique, Bargenron, White Barnissotte, Bermissenca, Betada, Bondance Precoce, Boutard, Caiana, Celeste, De Constantine, Early Violet, Grassale, Giuliana, Ischia, Lipari, Magdalen, Martinique, Mourenao, Nigra, Pergussata, Rocardi, Rondeletta, Trifero, and Verdal.

The largest sometimes grow five inches long, with an equal width, and are of the following varieties: Castle Kennedy, Col do Signora Panachee, Cordelia, Cotignana, Dalmatia, Dauphine, Dorqueira Negra, Douro, Ford, Genoa, Gentile, Grosso, Monstreuse de Lipari, Lampeira, Mouissouna, Osborn Prolific, Palopal, Black Portugal, Recousse Noire, Ronde Noire, Rouge de la Frette, Saint Esprit, San Pedro, Tapa Cartin, Vernissenque, Warren, and Zizi Kheda.



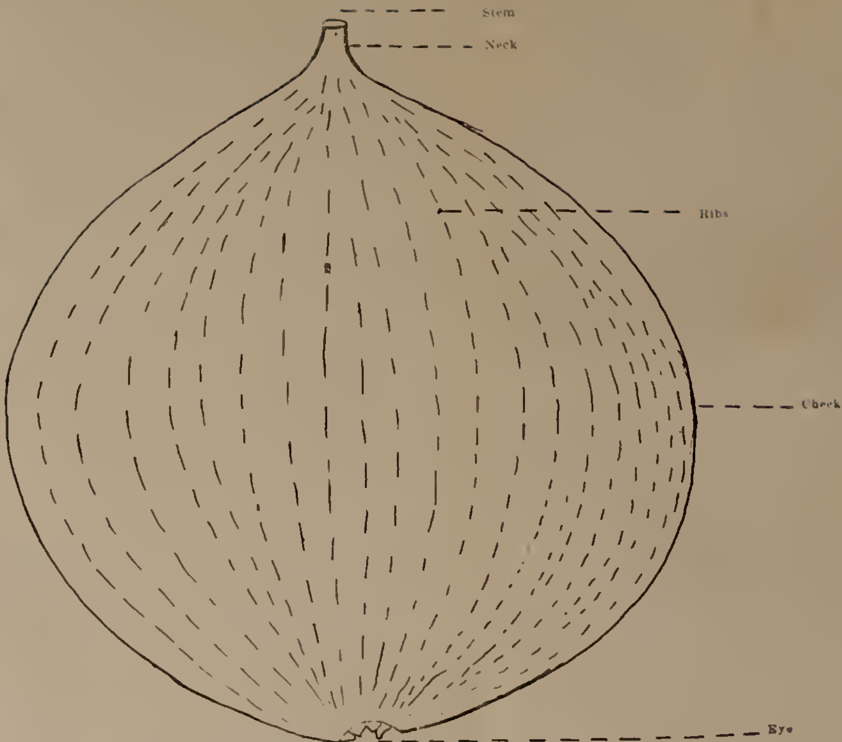
Lipari: the smallest of all edible figs. (Natural size.)

Although when properly cared for, in the South they bear a continuous crop from July until October; under different conditions European, African and Asiatic figs mature intermittently, the first being called brebas, and the second Autumn figs. Crops of capri figs are called, first, profichi; second, mammoni, and third, mamme, or winter figs, which last remaining on the trees all winter like buttons, furnish quarters for blastophagæ.

CHAPTER VIII.

THE PROPAGATION OF NEW VARIETIES.

As writers describe several hundred varieties of fig trees the creation of new ones is attended with few practical results. Eisen mentions three hundred and fifty-five, and gives sufficient detail to distinguish many. It can hardly be doubted that among these one can be found suitable to every particular purpose. There is no such thing as all around perfection in any one variety, any more than perfection is found in other fruit, for each stock is limited to characteristics suitable to a single purpose. "Varieties must be adapted to specific uses—one for shipping, one for canning, one for dessert, one for keeping qualities, and the like. The more good varieties there are of any species, the more widely and successfully that species can be cultivated." It requires several years to obtain results from each tree used for experimental purposes, and comparative tests, to be of any value, should continue over long periods of time. In this work more can be accomplished with known varieties than by originating new ones. In creating them several generations of careful selection must continue to develop stock that will "come true," as their tendency is to revert, and useless trees must be destroyed in great numbers. Varieties are not listed in this treatise, the references in the preface



Black Portugal: largest fig grown. (Natural size.)

leading to such information if desired, and as habits of growth are rapidly modified by changes of soil, climate and moisture, hard and fast descriptions often mislead, their value being chiefly historical. A tree grows accustomed to its surroundings, and will gradually adapt itself to new conditions. If removed toward the poles, or if taken from rich soil to poor or dry ground, its tendency is to become dwarfed, though remaining healthy; and dwarfed trees may be encouraged in growth by removal to richer soil and places having longer seasons. Variations in types are also produced by manipulating tops, and by treating the soil. These are often mistaken for new creations, and become so fixed in time as to be distinguished from the original stock.

Figs grown close to trees having male flowers sometimes contain fertile seed, which can be ascertained by putting them in water, for those which are sterile float, while good seed sink. Male flowers are usually grown on caprifigs, and new varieties can be readily propagated from them. They should be planted in sandy loam, about half an inch deep, and protected with glass until several inches high to prevent excessive evaporation. After the first year they may be set in nursery rows.

Seed generally produce wild figs, which are worthless. While, doubtless, valuable varieties were thus bred in ancient times, we have no authentic account of them. The Mitchell and the Meslin are supposed to be more recent seedlings, but their origin has been disputed. Seed have been planted in large beds, some horticulturists using a pint at once, and usually but one or two promising trees have resulted in each case. While they mostly produce wild figs, even those which are edible seldom have female flowers alone, and the presence of male flowers in the same fig renders it worthless, that part of the fruit where the male flower grows never maturing, but remains tough and woody. Some of our most valuable edible varieties grow male flowers the first year or two, but their number rapidly diminishes with age.

CHAPTER IX.

THE SIZE OF THE ORCHARD.

It usually requires considerable self-restraint for farmers to confine their fig orchards to areas they can cultivate intensively. Successful tillage is generally accomplished by persons whose operations are not hindered by family traditions about farming, and whose plans are unhampered by habits of thought that have become crystalized through paternal instructions; such knowledge often interfering with improvement. The ease with which figs are popularly supposed to be grown renders it difficult for an average man to limit his work to a field over which he can maintain complete control. Five acres is a good orchard for a farmer who has no grown sons at home; the first six months of each year it should consume about one-fourth of his time, and about all of it during each fruiting season. We remember the Greek who encouraged his sons to diligent tillage by the statement when dying that treasure lay buried in his vineyard, and how their searches were rewarded by bountiful harvests. Five acres well tilled twelve inches deep will raise more good figs than ten acres tilled six inches deep. The storehouse of plant food and the reservoir of soil moisture is beneath the surface, and when those immeasurable depths of fertility are stirred, and fined, the principal sources of vitality are removed to safer feeding grounds below the quickly varying, rapidly changing surface strata. Here soil conditions ever fluctuate from exposure to the rise and fall of atmospheric temperature, the velocity of winds, the amount of vapor above and other transient influences.

Compared with the usual cost of nursery trees, the price of stock is small. The labor of setting an orchard is also inconsiderable, as a mere fissure in the earth, made with a spade, is usually adequate for a young tree. In properly prepared ground two men should plant one thousand a day, and if in good condition all should live. Lands adapted for fig culture are available, reasonable and accessible throughout the South, and these conditions, and the high prices of preserves, tempt many into planting too much ground. A nimble farmer with the best tools and three good horses, can properly till thirty to forty-five acres, using all his time. From the first of the year he will be very busy until frost in the fall, and the crop will needs be harvested by others. While thus a slave to his orchard, with no opportunity for recreation and mental improvement, the farm will be his master. Instead of a "lord of his manor" he will not enjoy the primary results of toil, the fields will absorb his brain and brawn, and assume a mastery until he is finally claimed as its own. The individual, family and community are uplifted by diversification, and where activities are directed toward different interests, with one principal line of work, secondary matters often prove to be of the most considerable assistance and value. Cattle, horses, hogs, poultry, the family orchard and truck garden, the meadow, cornfield and pasture are all essentials of a well regulated rural home, and cannot be omitted without lessening the efficiency of the farmstead. Here they can be utilized with little comparative cost, and the least loss of time, resulting in the greatest possible profit. So, if a grower plants from four to six, not over ten, acres in figs, he will have a main industry and a principal source of revenue, one that will amply provide family wants, giving him time for secondary interests and the opportunity to improve his relation toward the community far different from the life of a drudge.

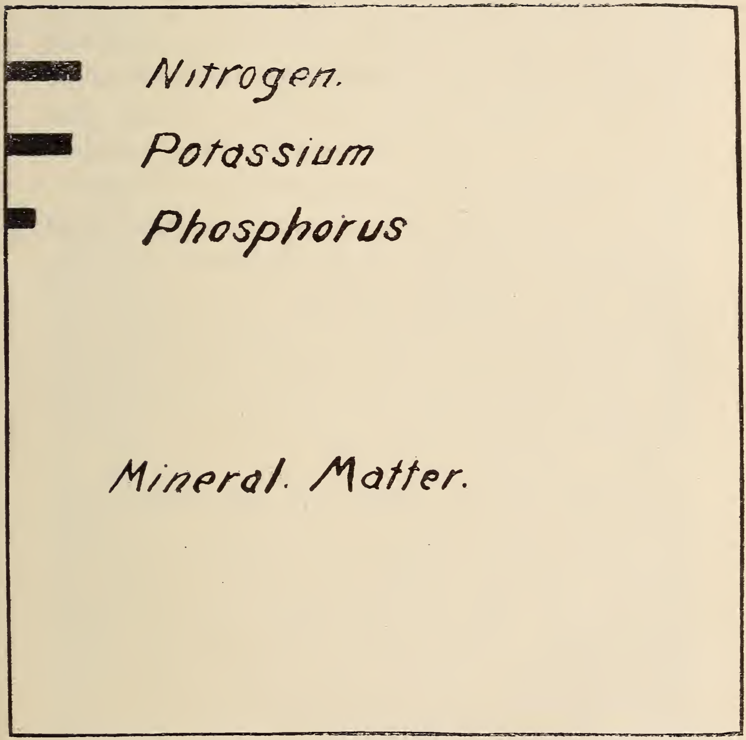
Since a fig plantation requires considerable capital, if the grower intends to maintain his farm upon a cash basis, or with reasonable provision against adversity, and still be comparatively independent of the market for fresh fruit, he should equip for preserving his own crop. In most cases this is a serious financial undertaking, as the following figures indicate: Ten acres should yield, annually, one thousand five hundred bushels. For gathering, preserving and marketing in first-class glass packages, it costs from seven to ten dollars a bushel; this estimate includes an allowance of three cents a pound for the fruit. Ten acres would then require from ten thousand five hundred to fifteen thousand dollars operating capital to handle each crop. This investment is partly for glass and sugar in the spring, and labor during the summer, with no returns until fall, and is very persuasive that, ordinarily, development should be confined to limited acreages until the growth of each business justifies its expansion into more formidable proportions. These figures will not carry weight with those who have unlimited credit, or adequate capital, but are suggestive to the ordinary man who is contemplating the culture of figs. If one has the resources, the technical knowledge, the broad experience there is no fundamental objection to a large farm, for its profits offer attractive inducements. The financial system of our country, although sufficiently developed to operate most enterprises on credit, where they are located in cities, has not reached that elasticity, and refinement, necessary to justify planting fig orchards in the hope of profit without substantial investment, and conservative horticulturists will be deliberate in expanding field operations except when placed upon rational cash bases.

Is fig raising on a commercial scale adapted to small acreages? Can it be made a profitable occupation for a farmer of modest means? When tillage, harvest, preserving and markets are considered, is it adapted to a family which owns but few acres? These are questions each inquirer must determine for himself, and if this book shall assist in guiding the reader to utilize from three to ten acres in a profitable way such encouragement to intensive horticulture will have justified its publication. The future of the industry appears to tend toward small farms thoroughly tilled, and its growth to considerable proportions to depend upon the care and skill with which limited premises are brought to conditions of reasonable perfection. Without venturing precarious prophecy we can tell from the well trailed present that a controlling factor in the future will be the encouragement average farmers receive to plant a few acres each—not dreaming of gilded millions made in vast plantations. Some distance northwest of Salt Lake City, sheltered on every side by snow capped Rockies, there is a small apple orchard, where, upon less than two acres, fruit is grown rivaling that of the world in size and quality, selling readily at twenty to fifty cents apiece. These superior apples find their way even to London and Berlin, where specimens occasionally appear more upon exhibition than as a market staple; but the intensive cultivation which precedes each crop, including even the training of limbs, selection of fruit spurs, and pruning of blossoms, is considered with that care and devotion which indicates an artist spirit directing the work. Such systematic labor, applied in our line, would result in thoroughbred fig orchards, for no one can forecast the extent to which trees may be improved by intelligent field work, their amelioration by evolution in breeding, and in the selection of parent varieties.

CHAPTER X.

FIG TREE FOOD.

In a general way the food of fig trees is the same that other plants consume—oxygen, nitrogen, hydrogen, carbon, silicon, sulphur, phosphorus and chlorine of the non-metalics, and potassium, calcium, magnesium, sodium, aluminum and iron of the metals. Although oxygen forms about forty-two per cent of their substance, it is taken from the air by leaves without effort to find a supply. Most other elements are either similarly inspired or exist in abundance in ordinary soils, so they may be at once dismissed from consideration. Vegetable matter contains forty-five per cent of carbon and six and one-half per cent of hydrogen, both of which are derived from air and water, so there remains but about one-fifteenth part of tree food, the supply of which is of practical concern. Nitrogen forms but one and one-half per cent of plant substance, and potash less than five per cent. These three—potash, phosphorus and nitrogen—are the only foods that have thus far become depleted in soils and they constitute less than seven per cent of the total. The practical problem is to maintain these ingredients, when needed, in such forms and proportions as to be most available and nutritious. How plant food is obtained and made into leaf, sap,



A diagram showing the proportion of nitrogen, potash and phosphorus contained in good top soil. The black spaces indicate these elements, while the remainder of the large square represents the relative amount of mineral matter.

fibre and fruit is one of the mysteries of life. We know that soil minerals are carried in solutions upward through infinite cells until they reach the leaves, where, coming in contact with carbonic acid and starch they decompose under the influence of heat, light and protoplasm, but how the plant knows the time to change starch into sugar, when to make protein, or to manufacture fibre, oil or cellulose will ever remain one of the miracles of creation.

There is no record of a chemist having estimated the quantity of chemical food consumed by an acre of fig trees. Reliable analyses have shown the amount used by wheat, corn, apples, plums, and other fruits, and the proportion of each. To those who desire to investigate this subject some general considerations may be of value.

We know that all plants must have phosphorus, potash and nitrogen or they cannot live. The ashes are mineral while nitrogen is vegetable or organic matter. For best growth some plants require an excess of one element while others prefer a different proportion. Lichen will cling to the tiniest crevasses in sheer rock, spreading its moss over crags, while the minute rootlets feed on slowly dissolving stone, making way in time for some more important vegetable growth. Long after the lichen has died ferns thrive upon humus formed by the decaying moss; then rocks disintegrate more rapidly. If ground to clay their minerals would be more available for plants, and vegetable growth hastens mineral decomposition. As rock, stone and sand are alternately washed and dried by rain and wind the exposed surfaces are worn and the fluids carry off phosphorus and potash. When these solutions come in contact with roots they are rapidly absorbed; if not, some form combinations with other chemicals and become solid again.

However, Dame Nature is not so resourceless as to provide but one method of soil formation. She works in many ways in the evolution of plant life. There are but few substances that are not continually oxidizing while exposed to the atmosphere, and all sorts of solids are gradually disintegrating into dust simply from the action of sun and air. Changes of temperature assist in this process, for the hardest granite gradually weakens until it breaks from alternate heating and cooling in Nature's laboratory. The expansive power of water in forming ice is a force which no mineral can withstand, and as crevasses wear in rocks they fill from rains, and freezes rend them asunder, shaking their solid foundations. The friction of moving streams wears all stones smooth, gradually grinding them to powder. Millions of tons of soil are always in motion by the ever young wind that disports from place to place. Earthworms digest the entire top soil every fifty years. Each crop of weeds leaves billions of little threadlike rootlets where air enters and higher plant life is supported by their decay. Every animal directly affects the physical condition of the soil by manurial returns, while all subterranean pests, such as ants, "crawfish," beavers, squirrels, gophers and moles are man's good friends in preparing the earth for his use, and enrichment, by their natural methods of tillage.

The creation of mineral plant food is largely a question of surface exposure to soil water; the ability of plants to avail of it is another matter. The quantity of mineral food in any soil depends mainly upon how fine the particles are divided and how well water can percolate through it around each particle. A single boulder has comparatively little surface; cut into quadrants the exterior is more than doubled; divide each quadrant into four more parts and the exposure is doubled again; continue this division until each cubic inch of rock has a billion soil particles and the surface is infinitely increased. If percolating water can surround each particle its opportunity to absorb potash and phosphorus is immeasurably greater than when unable to penetrate the single rock. We think of glass as a most insoluble substance, but if a tumbler be reduced to an impalpable powder and soaked in rainwater the solution will have three per cent potash and phosphorus. We must conclude, therefore, that the mineral food stored in all ordinary soils is adequate for plants an indefinite period of time. We can also infer that indiscriminate additions of min-

A tree ready to be weighed to determine the plant food contained in leaves, twigs, branches, trunks and roots; used in estimating by analysis the quantity of nitrogen, potash and phosphorus consumed by an orchard.

eral fertilizers is often a prodigal waste of money and labor. Soil should be brought to the highest condition of tilth and humus content before expense is incurred for mineral plant food.

"It is a very astonishing fact, but looked upon in the light of our experiments it is an actual fact, that all soils contain sufficient plant food for the support of plants. Further, when the plant takes into its substance some of the mineral matter from the solution the solid minerals in contact with the solution immediately dissolve and the solution is restored to its former concentration." (U. S., Bull., 257.)

An exhaustive analysis of an apple orchard was recently made. The leaves, wood and fruit gave a basis to estimate the quantity of potash and phosphorus used per acre; the soil was also analyzed. Results showed that in sixteen inches of top soil there was enough latent food to produce about two hundred consecutive crops, viz: potash adequate for one hundred and eighty-three years, and phosphorus for two hundred and sixty years. Similar analyses have shown that the demands of wheat, rye, plums and pears are about the same as apples, the facts forcibly illustrating that soil is a very storehouse of potash and phosphorus to be unlocked by every farmer who wishes by tillage and maintaining physical conditions congenial to plant growth.

The quantity of minerals drained from powdered glass indicate an elementary rule important in agriculture; it was found that three per cent of the glass dissolved in the percolating water; of course, the particles were microscopically fine. This demonstration gave reasons for the importance of tillage to every farmer in the land, promoting the widespread opinion among modern horticulturists that the maintenance of fertility is largely a matter of providing soil moisture where needed. The interesting revelation soon followed the above that as roots absorb minerals from this solution its strength is revived by additions from the same soil particles, so that with constant water supply the proportion of plant food remains about the same. Ordinarily, soil minerals resolve at least as readily as powdered glass.

By laying aside our traditions about fertility common illustrations of these facts can be recalled. One man raises potatoes on the same piece of ground year after year, the annual crop decreasing until too small for profit. He terms the ground "worn out" and leaves it idle for a year, or more, to recover vitality. While unused no mineral plant food is added; it is simply idle land, and yet, after a while, will grow potatoes again. Then there was always a sufficient quantity of potash and phosphorus. If the farmer had added fertilizers during the years crops declined he would have postponed the time when yields ceased, but the soil would have run out at last. Yet at the end of such periods chemists find the same quantity, and proportion, of potash and phosphorus that existed when the fields produced abundantly.

To illustrate again: potatoes failing, a normal yield of wheat may be obtained from the same land. Wheat uses potash and phosphorus in the same forms potatoes do. The relative proportion of minerals consumed by the former varies slightly from that used by the latter, but in either case the two minerals are essential to support plant growth. That wheat will thrive where potatoes failed shows that potash and phosphorus are not only abundant, but, further, are present in forms suited to vegetable uses. If abundant, soluble and available, then we must look for some other fact besides the supposed absence of plant food to account for soils wearing out by continuous cropping. Scientists have been searching for that result a long time; they have looked for some substance gradually increasing in quantity while one crop is grown exclusively, deleterious to it, and yet not injurious to other plants; that substance has been found to be their excreta.

"If there are toxic substances thrown off by plants which the soil is not in a condition to remove, or change at once, we try to change it at once by cultivation, by aeration, by oxidation." (U. S. Bull., 257.) This idea, though recently demonstrated by the Department of Agriculture, is not a new one. Lindley wrote, in 1839: "One function of the root bark is to give off such superfluous matter as it is necessary for its health that the plant should part with. If roots are so circumstanced that they cannot constantly advance into fresh soil, they will, by degrees, be surrounded by their own excrementitious secretions."

Virginia has a large area of worn out tobacco lands, which have been so constantly used they yield no longer. No amount of concentrated fertilizer will induce the growth of tobacco. These lands are often rich in humus and in good physical condition, producing an abundance of other crops. Their behavior points to the conclusion that tobacco has been grown so continuously its excreta has saturated the soil and is poisonous to that plant. We know that in power of absorption rootlets cannot discriminate digesting toxic solutions readily; and that plant fluids enter through membranes very near the root tips, newly formed wood throwing off an impenetrable bark as they extend, the corky cover protecting fibre from poisonous substances. We also see that roots continually excrete injurious solutions, for no one is able to make grass grow on the drainage side of large trees, though he furnish never so much sunshine, air and artificial fertility.

This question may be considered a digression from the subject of fig culture, but it is at the basis of tree life and orchard management. Unless the reader can assume that soil naturally contains sufficient potash and phosphorus he is not ready to study the more intricate subject of making natural fertility available, nor to consider the more expensive problem of maintaining adequate nitrogen, by natural means, and artificial additions. The soil is a storehouse of potash and phosphorus. This broad statement is not literal, but punctuates the fact that not only granite rocks and coarse sand, but fine clays as well, are composed in part of these vegetable foods. The roots do not push their tips into such substances; they grow by tissue building like coral reefs that rise from the bottom of oceans by accumulations of one minute particle after another upon the same foundations. They grow by ingesting food in solution, and build tissues out of dilute sap by chemical changes inside the trees. The tips of root hairs absorb liquid through membranes; hence we say that plant food must be brought to the root terminals in the medium of water. Rootlets digest the ingredients of former rocks, changing them into tissue and wood fibre, the terminals proceeding between soil particles by a process of accretion called osmosis. Like the building of an icicle it continues along lines of least resistance. The rootlets turn from lumps of clay, but grow rapidly in decaying organic matter. If soil has become cemented by rains, or baked in the sun, it is not congenial feeding ground. If trampled by stock while wet, impenetrable lumps have formed under each footprint. If plowed before becoming crumbly the furrow slices may have run together into large cakes of hard earth. In either event it is uncomfortable for roots, and results in dwarfed growth. A commercial tree requires conditions that force activity faster than its wild ancestor grew, and unless those artificial aids are abundantly supplied it will tend to revert to forest habits. Being a product of evolution it demands good treatment by modern methods of tillage almost as clearly as a human being requires a civilized environment, without which he degenerates with alarming rapidity. Upon abandoning a fig tree it rapidly becomes scrawny, scaly, sunburnt, frostbitten, attacked by nematodes and in every way shows inability to compete with plants of the wild. As well expect a college professor to continue his habits of life while stranded alone among savages as to think that a commercial fig tree can maintain itself in excellent condition when left to the ravages of primitive vegetation.

The supply of nitrogen is a most important consideration for every farmer. He must learn from the feel of the soil if it is needed, and how and when to add it; it is his first proper concern to acquire methods for maintaining an adequate quantity by economical and efficient tillage with such additions in fertilizers as may become necessary. Potash and phosphorus, comparatively inexpensive, are abundant and well retained in the soil without effort. But

Jar 1 contained in weight one-eighth grass mixed with powdered quartz; no other fertilizer.

Jar 2 contained ordinary farm land and fertilizer in the proportion: phosphorus 10 per cent., potash 6 per cent., and nitrogen 4 per cent.

Jar 3 contained ordinary fertile farm soil.

Seed was planted the same time in each jar. The growth in Jar 1 illustrates how well green manure supplies plant food.

nitrogen is costly, evaporates easily, leaches quickly, changes by denitrification into volatile compounds, and is altogether elusive. The principal sources are rain, atmosphere, manure and commercial fertilizers. All cover crops prevent leaching, while legumes, by accumulations from the atmosphere, leave nitrogen deposited in nodules on their roots.

Of course, nitrogen is merely an incident—a vital incident—of production. It is one of many elements of plant food, and an abundance of nutriment is but one of the indispensable causes of growth. Heat, air, water, tillage, texture and humus are each equally important for a crop. These elements compose fertility; the several metallic and non-metallic substances we are discussing are the sources of plant food.

It will neither be attempted to list the commercial forms of nitrogen nor to discuss their cost and comparative value. Such information is obtainable from numerous government bulletins, and textbooks. Our space is devoted to specific suggestions that will guide the grower in orchard work. Most commercial fertilizers contain less than four per cent of nitrogen, often two per cent. Then in four hundred pounds of chemical fertilizer, the quantity often applied per acre, there are eight to sixteen pounds of nitrogen. As soil has abundance of potash and phosphorus, for orchard uses, without that contained in fertilizers, its value depends largely upon this small addition of nitrogen, from forty to fifty pounds to the ton. Whether it is economy to buy fertility in this form is a matter of computation to be easily determined by each farmer. Figuring its original cost, the haul, spreading and mixing with soil, as compared with the expense of accumulating nitrogen from the air by growing innoculated legumes, and that saved from percolating rain water, it can be estimated which source is most economical. An acre of cow peas will ordinarily accumulate as much nitrogen as is contained in a ton of fertilizer, and deposits it in a state readily assimilated. The cow peas hold nitrogen in their roots longer than when it is spread in fertilizers, a fact greatly favoring the use of green manure. Consider their beautiful root systems, which offer such web-like protection against leeching, and their nodules break so slowly, the store is available over a longer period than when a definite amount is spread on the surface by manual applications. The pea roots themselves are of value, gradually resolving into humus, and if tops are plowed under the benefit is increased. So, if the cost of green manure is not greater than that of an equivalent quantity of nitrogen in commercial forms. the former should be preferred.

Chemists tell us that an inch of rainfall contains about one and one-third pounds of nitrogen per acre. If rain came regularly each week this supply would meet all demands of growing trees. But,

Roots of a Legume showing nodules where atmospheric nitrogen has been collected underground.

instead of adding to that in the soil, rain often causes a depletion. When several inches occur in one day, the soil becomes saturated, an excess drains away, or, standing, water-logs the land, and nitrogen rapidly evaporates. Soil will store about one-third its weight of water. If nine inches deep, it will hold three inches of water. During drouths the moisture content of the ground may get as low as twelve per cent; when the proportion of water falls below sixteen per cent. fig trees stop growing. Two and one-half inches of rain will usually fill a nine-inch soil. If the subsoil is dry and porous it will absorb considerable more; otherwise the excess must evaporate or drain from the surface. Sometimes rain water fills the interstices very quickly, and in half a day causes the furrowing and gullying of comparatively level land as it flows rapidly away; and when heavy rains occur at frequent intervals the greater part passes off. Then rapid depletion of nitrogen results from its loss in drainage. Underground tiles, however, are efficient to catch leeching fertility. Where tiles are used, and the ground is kept porous to their depth, nitrates are largely caught and held by soil particles before escaping. Every gentle shower is a benefit not only by affording moisture for mineral solutions, but by adding to the roots this most valuable, elusive and expensive element of plant food.

What, then, should the fig grower do? His soil should be deepened for feeding ground, for moisture storage, and for the accumulation of nitrogen. The ground should be tilled into a friable condition, so rootlets may grow in all directions, multiplying the sources of vitality. If beneficial crops cover the land during seasons of hardest rains, roots will hold leaching fertility for future use, while top growth will prevent furrowing and gullying by retarding surface flow. Just about the time slopes are worked into a finely divided condition they often slip down into bottom lands, from heavy rains, and leave the subsoil more or less bare; but if covered with an appreciable quantity of stubble from grasses, truck or grains, movement is checked, the woof of roots holding soil particles in place. Bermuda grass is the best levee protection our Louisiana neighbors have yet discovered.

We must not underestimate the value of commercial fertilizers, for a time will inevitably come with every orchard when the nourishment in the ground will be insufficient to sustain normal growth. The age limit of trees is largely dependent upon fertility. Transplant a short-lived one to fertile, moist soil, where evaporation is not excessive, and it will respond with vigorous growth at an age otherwise past its prime. In the South commercial trees are planted from ten to twenty feet apart, instead of in forty and fifty foot spaces, as in Asia and Kabylia, the nearness with which they stand in this country greatly hastening the time when no amount of cropping for manurial returns, nor soil manipulation, will supply adequate food; and when roots have well filled the ground the trees will either decline rapidly or the grower must make large additions of commercial and barnyard manure.

In 1907 and 1908 an experiment was made to ascertain if there is a limit to practical tillage beyond which results are detrimental instead of beneficial to trees. Burkett well says: "The interchange of acids and gases always is taking place in the soil, but it is more active when a disarrangement of soil particles has occurred." This familiar principle is the basis of tillage, and encourages us to stir the ground, that by such disarrangement of soil particles the interchange of acids and gases may be encouraged, and plant solutions formed more rapidly. Selecting a row of fig trees in all respects similar to those which paralleled it, the ground was plowed around them every week, or ten days, from the beginning of the growing season until the middle of summer, when each experiment was discontinued, the results being obvious. After each plowing it was well harrowed to maintain a good earth mulch. The rows had a natural slope toward the south, adequate for drainage, and were not allowed to suffer for moisture. About three weeks after excessive cultivation began the trees appeared more active, and this difference increased as the season proceeded. Fruit set as usual at the axil of each leaf, but the joints were longer. By the first of

June the foliage was lighter colored, the fruit did not show the plumpness that characterized the variety, and two weeks later it began to drop from the lower limbs, little remaining at gathering time except that which was very immature. Notwithstanding the increased wood growth, these trees did not produce so well—nor at all until very late in the summer, some maturing after the experiment ceased. There is a point in cultivation, then, beyond which it is dangerous to go, and fining the ground too constantly causes its fertility to deteriorate more rapidly.

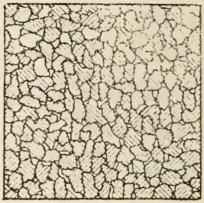
CHAPTER XI.

TILLAGE OF FIG LANDS.

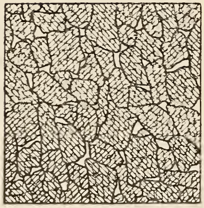
Tillage began by pulling up virgin growth to make room for seed. The next step was the removal of weeds to give chosen plants more room. To-day we think of it as a custom, but the art is primitive with many, and only since yesterday have scientific principles begun to be understood. Pioneers have always been adventurers; after them have come stockmen, then grain farmers, and lastly truckers and horticulturists with intensive work. Stockmen farm on horseback and ridicule scientific work; men who study soils, drainage, plant food, tree selection and fruit markets are very different individuals. Fifty years ago those who practiced scientific horticulture were confined to the "gentlemen" class, to whom farming was a diversion, nor has it been long since Daniel Webster added materially to the art by inventing an improved plow.

Tillage of fig orchards differs from ordinary cultural methods only in detail. There is a widespread impression that fig trees do not need cultivation; that cuttings can be put in the ground and left to grow a couple of years, until the owner returns for a harvest. "They produce abundant crops without any care or attention," wrote an official in a recent bulletin. That so many entertain this belief illustrates the lack of knowledge of the subject, for nothing could be farther from fact. Figs respond more quickly to good treatment than any other fruit trees, except olives, but become dwarfed and blighted by one season's neglect. With congenial surroundings, they often make six feet of growth a year. Considering that every pound of wood requires about five hundred pounds of moisture to convey vitality from root ends to branches and leaves, some idea can be formed of what trees need as to water and depth of soil. Roots often grow ten feet the first season, soon forming a closely interlaced mesh in every direction from the trunk. If soil is merely scratched on the surface an inch or two deep, they soon suffer, pale foliage indicating insufficient nourishment. It is just as unreasonable to expect a fig tree to grow well in improper soil as to believe a child will develop if denied sustaining food. In one case vitality is derived from the assimilation of organic matter containing traces of metalic compounds, while in the other it comes by digesting organic and mineral solutions.

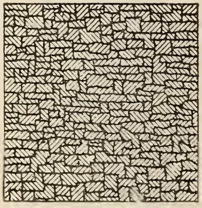
The student of tillage never forgets that the better soil is pulverized the more abundantly it gives up plant food. It is composed of minute particles, which ordinarily measure one-tenth to five-one-thousandths of a milimeter in diameter. When raw turf is plowed the furrow slices form lumps, or clods, which require repeated harrowing to wear down into anything like comfortable beds for cultivated plants. Farm implements, aided by frost, rain and sunshine, work land into friable conditions in three or four years. At first the lumps are so



How soil particles look under a microscope, showing air spaces.



This cut shows the particles partly run together with some air spaces left.



Clay soil that has "cemented" and become impervious to ordinary roots from packing rains. It needs humus between the soil grains.

large there is no capillarity, air circulates in the interstices too freely, promoting excessive dryness, while the clods are impenetrable to roots in search of food. If new soil is plowed deep, and fined with a disk, or harrow, it will often deceive an observer unless he digs below the surface, and young trees planted therein dry out very rapidly, the coarse lumps giving inadequate homes to roots. The complete loss of a setting of sixty thousand fig cuttings last year was due to this condition, for the harrow pulverized only the visible surface.

The best initial treatment for prairie sod is to plow just below the grass roots in spring or summer. Such sod will disintegrate by fall, and much noxious acid escape. Where sod is plowed deep the first time its tendency is to sour an already acid soil; it is better to burn the grass first. Sod breaking should be followed by deep plowing in fall in time to get the benefit of winter rains and weather. During January the ground should be thoroughly harrowed, plowed a third time the following month, and then planted. By this treatment, if rainfall is normal, it can be conditioned in one season. Some land is so light that sod may be turned under deep, thus avoiding the second plowing. For satisfactory results with reclaimed marshes and swamp lands, the growing of some rank crop, such as sorghum, a year before planting trees, will be found almost necessary. It is not beneficial to harrow the ground sooner than a month after the second plowing, unless absolutely necessary for want of time, for the weather greatly improves raw land, and a rain or two is very beneficial to upturned turf. There are other methods equally as good as the above for bringing prairies into cultivation, but they will not obtain results with less labor.

The future of an orchard depends largely upon how well trees become established the first year. Frequent cultivation encourages growth. To help them start, at the beginning of the season, throw a couple of furrows toward each row, right up to the trees; the addition of warm, mellow ground where most needed will be rewarded. The double shovel is an excellent tool to use close to young trees, as it stirs quite deep, giving feeding ground for lower roots. If a root is exposed to the sun for half an hour in dry weather it should be pruned, as within that time all tips will have died. Plowing once a month will not injure the trees, if shallow, but one deep plowing in winter, followed through the growing season by disking, will prove satisfactory. Never turn subsoil to the surface; use a plow in the bottom of the furrow, for it becomes friable very slowly, and, containing the excreta of former vegetation, is injurious unless gradually mixed with top soil.

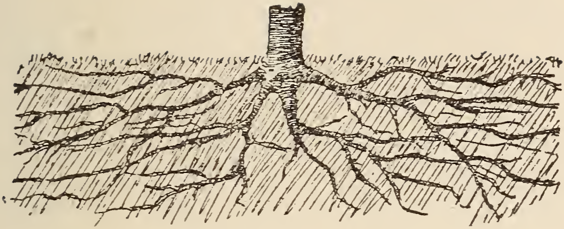
The first year a farmer will learn how fig trees behave, when in trouble, so as to properly minister to special wants. Tillage is an art that has never been perfected, having just reached an experimental state. Perhaps one tree needs a lump of lime to correct acidity; another being too high above the land level may require a mulch of straw, or a grain sack, to protect it from wind and sun. Moisture is often insufficient, and, during prolonged drouth conditions may be improved by scattering a few hundred pounds of salt per acre to collect vapor from the atmosphere, thus adding five or six per cent. to ground water. These and other interesting problems will perplex him, but if he loves to see trees grow the hours in his orchard will be genuine recreation, and the while he will be learning mysteries of Nature.

It is a safe rule to keep work teams off fields at all wet times until the earth crumbles when pressed in the hands, and the injury to its physical condition by trampling is avoided. Wherever an animal steps on wet clay an impervious lump is formed, the depth of which is in proportion to its weight, and stock, even swine, may undo the work of years by so packing the ground that its fertility cannot be restored except by several seasons of patient labor.

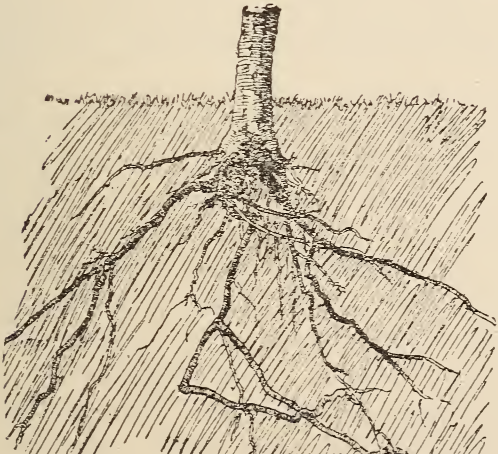
CHAPTER XII.

THE SUBSOIL.

In the South raw prairie usually has a shallow top soil. By soil we mean that layer of ground into which grass roots have penetrated, and by their decomposition little channels for air and water have been left, resulting in its darker color; humus has formed from the roots and tops of vegetation, and oxidation has taken place as far as they have penetrated beneath the surface, thus modifying the original color and texture of the turf. Some of the muck lands of Southern California have more than twenty feet of top soil; in the Mississippi Delta the alluvial deposits are not shallow, and in many parts of Louisiana humus exists several feet from the surface; but the ordinary prairie lands along the Gulf often contain less than six inches of top soil. In the North Central States, where land freezes several feet deep, water pulverizes it when changing to ice, the particles becoming finely divided by alternate cold and warm weather, and is pervious as deep as freezing ordinarily occurs. In the far North, however, seasons are too short for plants to occupy the ground as far as it freezes. Roots gradually enter porous soils, and, if supplied with sufficient moisture, they continue to whatever depths are found comfortable. If top



Root system of a tree growing in hard subsoil.



Root development in an open subsoil.

soil is thin and barren, trees become dwarfed and stunted; but when fertility extends to considerable distances plants make hardy growth.

When fig raisers select thin soil for orchards, deeper feeding ground should be gradually developed. There is a limit to the size of every tree, but normal habits should be cultivated. If they grow two feet of new wood each year, the farmer should be content, for they are not suffering for nutrition. When conditions are favorable trees will grow about five feet the first year, and six the second. By that time their roots will have utilized much of the ground within ten feet of the trunks. The third year growth should exceed that of previous seasons, and should continue to increase so long as sufficient fertility is available. But it is difficult to find orchards that have developed progressively after the first three years; while branches continue to multiply, the rule in the coastal country is for diminished length of new wood. The careless manner soils are handled, and the evident neglect to maintain proper texture and physical condition, is responsible for the decline of trees that give every promise of vigor while young. It should be the first concern of the grower to develop a depth of soil that will aid trees in searching for food. An orchard near Galveston, famous six years ago, and advertised all over the country, three years later yielded but twelve pounds of fruit per tree, wood growth being less than four inches the entire season. This orchard produced no palatable figs at all last season, and what there were ripened before the middle of August. For five years the ground had been worked solely with a disk, no fertilizers being added.

A most experienced nurseryman seriously contends that fig roots grow in three layers, the first being surface feeders just under ground, the second intermediate about six inches below, and the third strata about a foot further down. Trees on his farm do not show such systems of growth, nor is there any data justifying their division into layers. The fact is, figs form a symmetrical system of roots which tend downward, and their direction is only diverted when checked by obstacles or impervious clay.

When soil is to be developed to greater depths, what methods should be used? The question is a general one, and mostly beyond the purpose of this work. Ordinarily it takes about three years to so reduce subsoil that it will contribute plant food. If it could be thrown repeatedly in the air it would tame much faster. Deep plowing will bring it to the top, but dangers result, as has been suggested. If it contains toxic acids, or noxious compounds, in excreta of former plants, such might seriously interfere with tree growth. Then subsoil turned to the surface forms hard lumps, hindering cultivation, promoting evaporation, and being unpleasant. A better method is to follow one plow with another,

Typical Magnolia Fig Bushes, two years old. The leaves have been stripped to show the fruit. The pendant fruit is ready to gather, and should fill a peck measure. Notice the extensive root systems and their development.

going twice in each furrow, and by using a narrower one in the rear the subsoil is thrown partly out upon loose ground, then covered with top soil turned into the bottom of the furrow. It is thus gradually pulverized and aerated without being brought to the surface at once. A subsoil plow may be conveniently used in this process. The observant farmer will readily find which implement acts best in each field, and his selection can then be intelligently made.

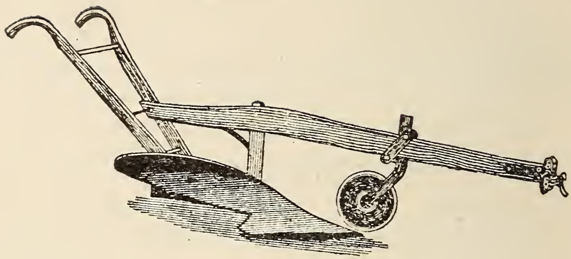
CHAPTER XIII.

TILLAGE TOOLS.

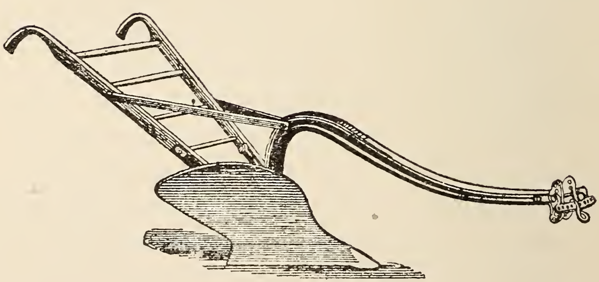
The best investment for farming is a well selected assortment of tillage implements. Even serious minded persons sometimes try to keep pace with more thrifty neighbors without sufficient field tools. For a horticulturist to rely solely upon a plow and harrow will handicap him as greatly in his work as a surgeon with only a knife and needle, his efficiency being lessened as much as a carpenter's with simply a plane and saw. Such farmer, surgeon and carpenter might accomplish material results, but competitors using better implements would outclass their work. This is so self-evident that it almost requires explanation for the statement; and yet there is such need for stimulation among the rank and file of the profession, in the matter of equipment to meet the constantly changing difficulties of everyday life, that conditions justify its constant encouragement. He who accomplishes two or three times the work of his neighbor each day, through better preparation, is the one always showing results at the end of the season, his fields being properly tilled, while those of others languish and become impoverished from want of attention. Success gives stimulus for further labor, and a momentum of enthusiasm is acquired which carries one over the crises of crop raising, and harvest, that come between rains and during droughts, when a day's labor saved may determine the result of a year's work. A scenic artist can not paint pictures with a shoe brush, be his skill never so great, nor can a farmer raise good crops with only a plow and harrow.

THE PLOW.

The plow is the basis of tillage. It is a remarkable wedge that moves underground in both horizontal and vertical planes, and, for the draft, lifts more dirt than any other implement. The disk is a close competitor, but cannot be adapted to so many conditions and varieties of soil as the mould board plow. A good one does not invert the furrow slice; rather, it causes the dirt to fall on the edge of the slice to crumble and fine in settling. As much virgin soil should be plowed each year as one is willing to pulverize and fine by subsequent tillage. There is no virtue in turning great lumps from the subsoil unless reduced to a condition usable for plants; otherwise they interfere with tillage, expose good soil to rapid evaporation, and greatly impair the value of the earth mulch. By all means plow fig orchards once during the winter, as deep as the soil and roots will allow, relying on surface tillage afterwards.



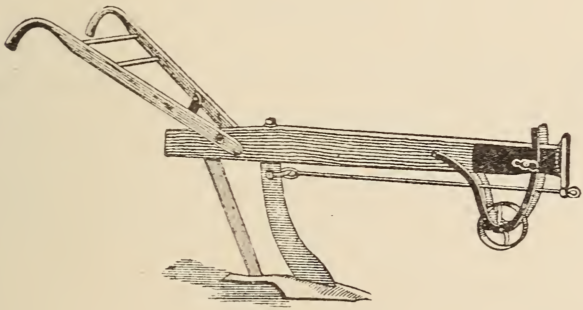
An approved Sod Plow.



A good plow for old land.

SUBSOILERS.

If subsoil can be gradually worked to the top it will tame without impairing the texture of the earth with which it mixes. Three or four years is usually required for subsoil to become nutritious to roots. If turned at once to the top of the furrow the change proceeds faster, exposed to air and sun, but seriously retards the beneficial action of old ground. There are several subsoilers on the mar-



Subsoiler.

ket shaped like a barbed tongue curved downward, these being fastened to the heel of the share; some scrape the bottom of the furrow, and others turn up a narrow groove—most of them do good work. To follow one plow in the same furrow with another of a narrower gauge is a simple and efficient method, elsewhere explained, as the second plow throws dirt only partly toward the top of the furrow ridge, thus gradually mixing the new with old ground without exposure to the surface until later. Careful subsoiling will increase the depth of fertile ground; if done while the trees are young enough not to be injured by the mutilation of their roots it is very beneficial, literally doubling the size of the orchard when most needed. Five acres of land with a ten-inch soil will afford as much plant food as ten acres five inches deep.

HARROWS.

The simple process of time worn harrowing should need no comment, and yet such is the force of traditions and habits of thought that this work is usually done by boys, seldom receiving more than casual attention. The object is to fine the surface so that little particles of dirt fill the interstices. The surface of fresh plowed ground is very uneven, that exposed to evaporation measuring many times the area of the field. As one of the chief objects of tillage is to conserve moisture, unless promptly fined it will soon dry beyond the point at which plants will grow. The chief function of harrowing is to work clods and coarse ground into crumbly beds. Do not use a heavy, straight toothed beam harrow, but invest more money in an iron frame sectional one with adjustable teeth. The difference in price will be saved during one week of service. With adjustable teeth it can be used to tear up sod, crumble ordinary fresh plowed land, break new crusts, kill weedlets, and as a drag for leveling, all with greater economy of time than by the use of any other implement.

But the drag harrow is not alone enough. It covers the orchard in a hurry, holding it in condition after rainy spells until treated with such implements of deeper tillage as occasions require. If weeds have started so drag harrows will not kill them the acme is most efficient, working the ground in a number of little furrows about two inches deep with movements that thoroughly stir the top. To these add a spring toothed harrow, this going deeper than other kinds, and doing excellent work; it is really a cultivator. After using these a few weeks experience will suggest requirements and tools to obtain desired results.

OTHER TOOLS.

Every orchard should have a disk—it is indispensable. Though not going so deep as the plow its action is the same, tearing and fining as it goes. It compacts the top soil at the same time, and creates the right depth of earth mulch, which can then be maintained with lighter tools. You will plant cover crops with it, and use it to seed the ground down for the winter; to stir a crust that has become too hard for harrows, and to kill noxious weeds of considerable size. Consider that it works the field five times as fast as plowing and the saving in time and expense is readily estimated. First cost is inconsequential as it will cover ten acres a day.

One of the most valuable implements the first year and the second spring is a double shovel, especially so if the ground is clay or clay loam. The points can be worked down as close to the trees as roots will permit, nearly as deep as a plow, thus making a friable soil where most needed. Always follow with a harrow, or drag, to smooth the surface.

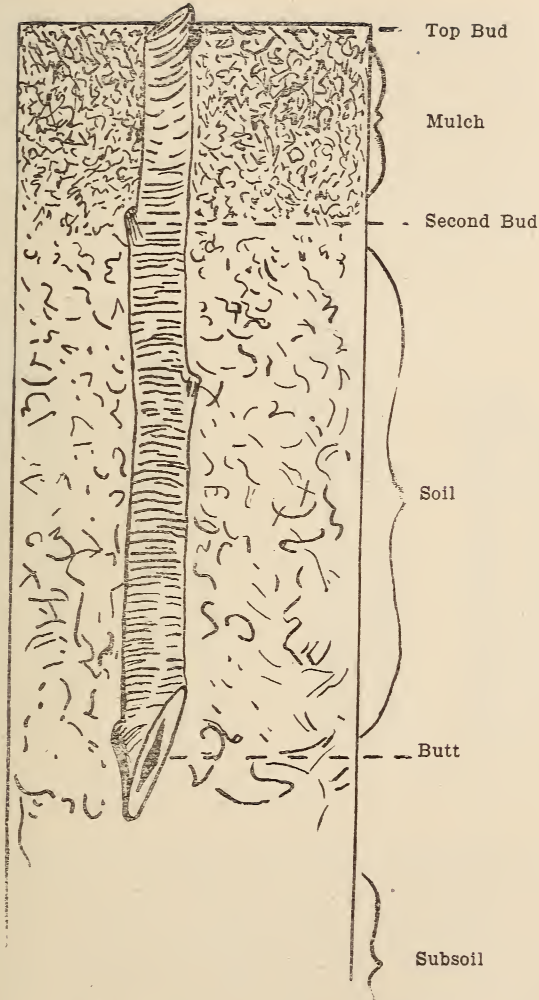
A roller is dangerous for a fig orchard, unless the soil is very light. If the ground is dry it will aid in maintaining capillarity, as then its pressure will cause moisture to rise from the contents below. We press our heels around the standard of a tree, when setting it out, to compact the newly moved earth and prevent drying; and the roller may be a timely aid to obtain the same results. But even then, if efficient in compacting the soil, it will be an injury afterwards unless the surface mulch is at once restored by harrowing to destroy capillarity at the top.

Unless intertilled crops are raised these tools should be sufficient to meet every requirement. If cover crops are planted in rows between the trees, or inter-cropping done, while the orchard is young, the farmer should add a one-horse V harrow, and a good cultivator. A weeder will also be an efficient aid.

CHAPTER XIV.

ABOUT CUTTINGS AND THE TRANSPLANTING OF TREES.

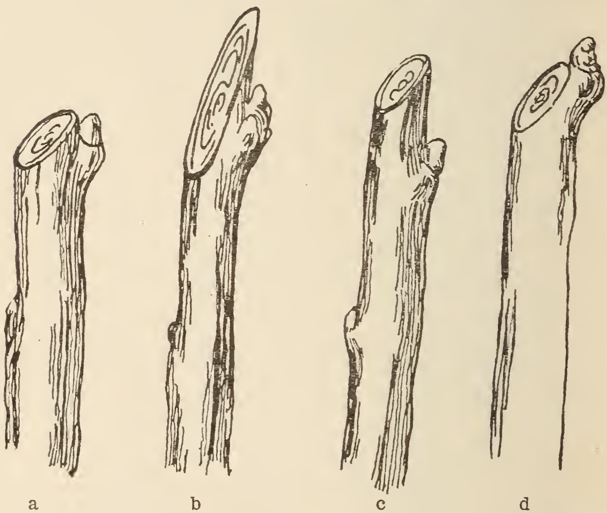
In making fig cuttings some benefit is derived by severing each limb just above a bud at the top and just below a bud at the bottom. It is still more important to make the lower cut smooth without injuring the bark, as is often done with a shear shank. When bark is wounded around the butt it interferes with "callusing" by the lateral wood processes. Cuttings should be made from well matured stock, newer wood having less vitality, however, most nurserymen consider it unfit if more than two years old. The larger the diameter of the cutting the more latent vitality and the greater its resistance to adverse weather and soil conditions. The length should be determined primarily by the depth of soil where it is to be planted; no empiric rule can be stated for determining length, but several illustrations may be of service. Where soil is in good tilth for twelve inches, or more, and the level of ground water is below that depth, cuttings can be safely made from a foot to sixteen inches long; butts should never reach below the gravitational water level. Where soil is tilled shallow they should be made relatively short; there being no benefit from inserting them into subsoil. If



A Fig Cutting properly placed in the ground. In Smyrna the natives cover the top about a half-inch deep with dry earth.

top soil is coarse and open, with a loamy strata underneath, cuttings should be long enough to reach through the rough surface into better earth below.

There is no virtue in exposing any part above ground, as tops dry in a few days; in Smyrna they are buried. Soil should be loose enough for laborers with gloves to press them down without injury

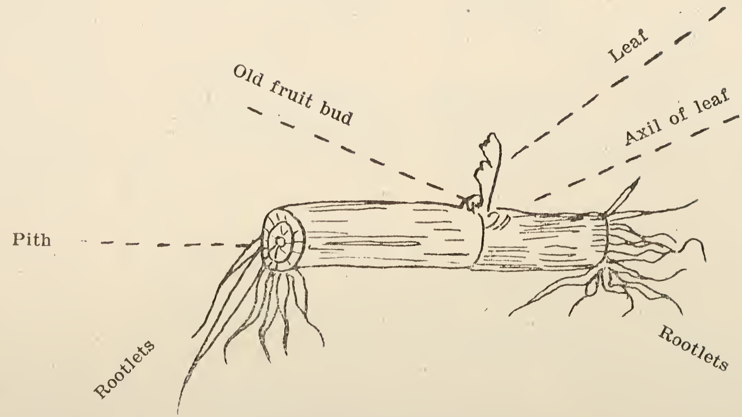


Upper ends of cuttings as often made. *a* correct, *b, c, d* incorrect.

into the surface strata until the tips are just visible to a person standing by. In such case each top bud, and usually the second one, will sprout an upward growth. Under very favorable conditions cuttings extending above ground even a foot or more will sprout at all exposed buds; but as a rule they die, for the proportion of leaf area to roots is disarranged, it then being difficult to get food from below sufficient for the large evaporative surface of leaves. More cuttings are lost when thus treated than if better opportunity is given for stronger initial root growth. Comparatively few cuttings die without sprouting, and many small dry leaves on long tops of the dead indicate that insufficient nourishment, from lack of roots, failed to supply the demands of large tops, there being ample vitality in the wood. If the earth is tilled only three or four inches deep cuttings of that length will do very well. Roots will sprout through the bark at the lower ends, as well as at the butts, their growth ordinarily being normal.

Fig limbs grow well and make good trees when entirely covered up in furrows. The objections to this method of propagation are that roots tend to lateral development instead of going downward, resulting in an awkward looking tree that is not commercial as nursery stock; and, being connected in trenches each top is firmly attached to many others, and are difficult to transplant.

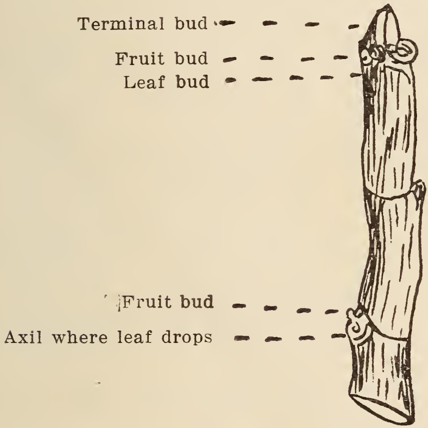
The best root systems develop from single buds. This is done by planting cuttings, each containing one bud, about an inch below the surface. The roots tend downward more noticeably than by any other treatment, and develop with attractive symmetry. Such cuttings require protection from ex-



Single Bud Cutting.

cessive evaporation by glass until well established, and the first year's growth is considerably less than if more wood is used.

After sprouting cuttings can be stimulated by repeated cultivations, and they respond best when the earth is stirred every ten days. If the ground

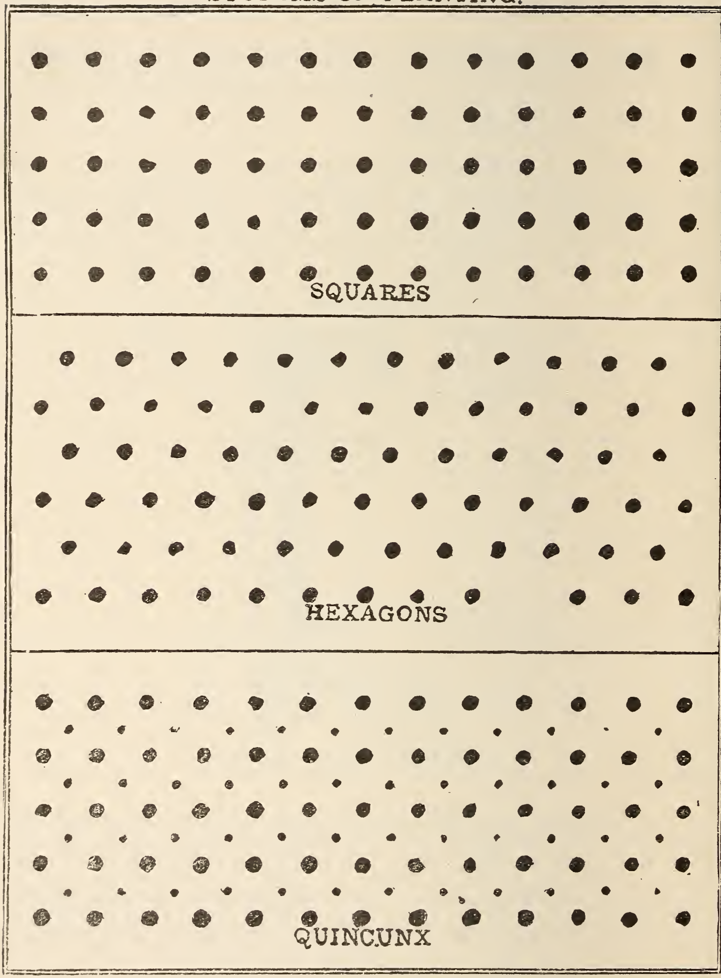


Terminal Bud Cutting.

is inclined to be acid a ridge should be carefully made along each row by plowing toward the trees a couple of times without raising the crowns above the land level; if crowns form too high it will cause much trouble in after years.

Cuttings will grow from two to eight feet the first year. Experienced buyers prefer average sized stock, as larger trees tend to make wood instead of

SYSTEMS OF PLANTING.



● PERMANENT TREES. • TEMPORARY TREES.

Diagram showing three systems of orchard formation, the hexagonal being often preferred, as more trees can be planted per acre the same distances apart.

fruit. Great care should be taken in transplanting from nurseries, the roots being very sensitive to air, and when once dried cannot be revived. Cuttings will endure considerable neglect and by placing them alternately in water for twelve hours and then airing them in the shade the same length of time, they can be carried over a considerable period, and even revived when apparently dead. But dried roots will not become lively by any treatment, and should be pruned off. The test for roots, as well as for cuttings—in case of drying, frost, or other injury—is to cut quickly through the tissue with a sharp knife and watch the sap appear in the pores of the wood; if it flows freely, milky white, the wood is alive; if it comes slowly and is thin and watery, the wood should be cut back farther, or if a cutting, its further revival by immersion and aeration should be continued.

CHAPTER XV.

PRUNING FIG TREES.

About a century ago Thomas Andrew Knight, the highest authority of that time, wrote in Horticultural Transactions that pinching terminal buds of fig trees stopped the elongation of branches and repulsed the sap to be used where it would improve fruit; that by bending sterile branches downward, and fastening them with considerable strain wood growth was checked, and they were rendered more fruitful. In 1839, Lindley described a system of removing two-thirds of the new wood each year, by which treatment, said he, "the fig tree has been rendered more fruitful than by any other method." Of fruit pruning, said the same writer: "If the late figs which never ripen, are abstracted, the early figs the next year are more numerous and larger."

The persuasiveness of these authors should cause experiments to be made along this line by every grower. The facts they teach, described by all modern botanists, result from prevalent opinions that anything which checks growth of top wood, or fruit, causes the vitality of the tree to be stored within the tissues, unless immature fruit exists, in which case it is concentrated in enlarging what remains on the tree. Fig growers around Paris regularly prune terminal buds, and remove some of the

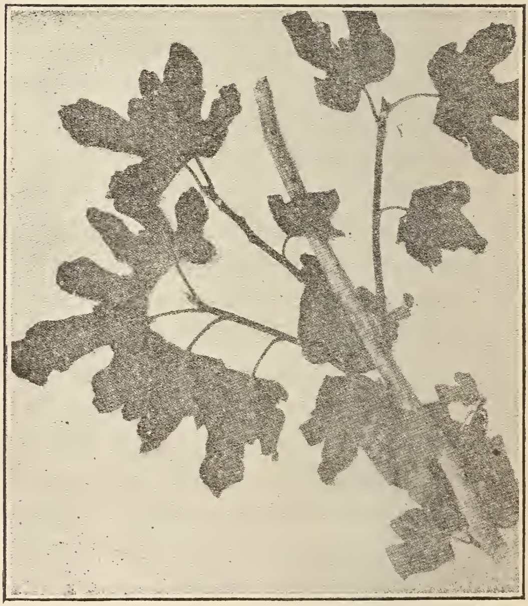
The cut shows how latteral branches form when terminal buds are pinched.

side branches, which soon sprout near the ends, those left being promptly checked in order to divert growth from wood to fruit.

These considerations caused experiments to be made in the South to test the effect of destroying terminal buds. In the experiments trees were treated in groups, one group having all terminals removed early in the season, a second group a little later, and so on until ten comparative plats were formed. By the side of each plat trees grew naturally. All pruned plats gave negative results; for, without exception, the treated trees yielded less than untreated ones; lateral branchlets developed on about ten inches of the stems, and no increase of wood or fruit could be seen below that distance; while those few inches where branchlets grew developed no figs, although having time to mature. Perhaps, by pinching the terminals of each lateral branchlet the sap could have been turned further back. This, however, is doubted; for a fig matures more quickly close to the leaf than upon a bare limb, the leaf having attraction for sap of which fruit derives benefit; and as each leaf always falls before the fruit at its axil is ripe, so much reduction of leaf area by terminal and lateral pruning should result in checking the growth of each entire branch; field observations confirm this conclusion.

Corbett thus summarizes the objects of pruning in general: "The gardener, therefore, has as reasons for pruning trees, the removal of dead, dying or broken branches, the reduction of the annual growth for the purpose of correcting the habit of the plant, the removal of branches in order to prevent the breaking or disfigurement of the tree in later years, the removal of branches and fruit spurs for protection against infectious diseases, and the reduction of the annual growth in order to reduce the crop in proportion to the capacity of the tree.'' (U. S. Bull. 181.)

The cardinal object of pruning fig trees is to encourage as great a growth of fruit bearing wood as is possible up to the middle of July, each season. Fruit set upon such wood has time to ripen before frost. The usual habit is to set fruit not upon year old spurs, as the peach and plum set fruit, but upon new wood like most grapevines. This object can best be obtained with the Magnolia fig by severely pruning the top each winter. If pruning is done for the greatest benefit to the tree it should begin about the twentieth of February, and be completed by the fourth of March. If primarily to obtain good cuttings, it should be in the fall, to give time for the ''callous'' of latteral fiber at the butt of each. Great deterioration of trees usually results from early pruning, wounds being seldom protected, the wood dries very rapidly from each cut, often losing life twelve to eighteen inches down the branches. Sometimes whole orchards have been pronounced fatally frosted by mistaking



This limb was pruned in the fall, and about two feet of wood died from evaporation during winter, while the whole branch was weakened by the loss of sap.

the cause of a weakened condition of the trees from early pruning. However, if done in the fall, and each wound is protected from evaporation by paint, or other impervious substance, the top should come out stronger in spring than when pruned late, for in that event the roots, which are never dormant, will have concentrated their winter's work in less wood than when all tops remain until just before spring.

A Dooryard Fig Tree in the South

CHAPTER XVI.

CONSERVATION OF SOIL MOISTURE.

Fig trees are peculiarly susceptible to variations of moisture, an inadequate supply affecting their growth very quickly, while they respond to the addition of normal quantities of water and recuperate from drought quite readily. Trees that receive no tillage often drop both leaves and fruit at least once every summer, unless rain is frequent, and it is not rare to find them dormant as many as four times in one season. Their nature is to make rapid growth, and the cellular tissue being coarse and soft sap moves quickly, if given sufficient water, making at least ten times the weight of wood that the peach, pear or plum does in the same length of time. Each pound of fiber requires about five hundred pounds of water as a medium of transmission. Water is the solvent of plant food in the soil and the conveyer of that solution to different parts of the trees, where, in new chemical combinations, it changes to protoplasm, fiber, fruit or oil. Air and sun extract it through the bark in contiuning evaporation while leaves exhale it from every point in remarkable quantities. So important is the function of water that its conservation is one of the primary objects of tillage.

Illustrations of water movement in plants are

A favorite yard tree, the fruit being sweet and juicy. Notice the leaves, which make large evaporative surfaces in proportion to wood, and transpire water rapidly.

made by pot experiments. It is impossible to weigh a growing fig tree several times a day, to ascertain its water content, but by placing some such plant as a sunflower in a pot and protecting the soil from evaporation and rainfall, a measured quantity of water can be given it daily and that expired through leaves is thus ascertainable. A single sunflower stalk with eight leaves was found to lose one pound and fourteen ounces during a warm dry day, one pound and four ounces during another day not so warm, three ounces in a night without dew, while it absorbed four ounces of moisture during a foggy night. It is probable that a common fig bush will transpire no less than a half gallon of water a day during warm growing weather.

In arid regions, such as Arizona, New Mexico and Nevada, the first step in cultivation is to create an adequate storehouse to hold the scant rainfall in the ground, and by improving the texture of the soil with humus and deep tillage to make the winter precipitation available during the long dry summers when plants draw capillary water toward the surface for their use.

The following table pictorially represents the importance of humus as a means of retaining moisture in the soil:

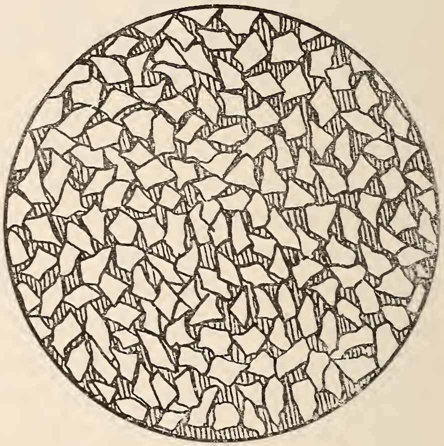
Kind of soil	Pounds of moisture.	Pounds of dry soil.
Sand	19.60	100
Clay loam	32.40	100
Humus	114.60	100

This estimate was based upon weights after a good rain, and very clearly shows one of the chief functions of humus. Humus is even more essential in light soil than with clay, or silt lands, for, while in the latter case it percolates more rapidly by the addition of humus, in the former instance the moisture retention is poor and it becomes necessary as a means to avoid the rapid fluctuations that follow changes of weather; without humus our sandy loams fail to respond reliably to tillage, and change beyond all control in their plant producing power. With a million root hairs on every tree straining the moisture into its circulatory system the water content is soon reduced, and when it becomes less than twelve per cent fig trees are unable to grow. If the soil is entirely filled with water it is non-productive, and as, ordinarily twenty-five per cent is the maximum quantity of water it will retain, unless organic matter exists in considerable proportion, there is only a margin between twelve and twenty-five per cent when cultivated trees will grow.

A convenient division of soil water is sometimes made by calling that which passes downward in drainage gravitational, being moved by gravity; that remaining in the interstices capillary water, as it moves up and down and somewhat laterally wherever capilarity exists; and those tiny films which tenaciously adhere to soil particles refusing to be pressed or dried therefrom are called hygroscopic water. This distinction aids in conceiving the functions of tillage, for gravitational water is injurious to all fruit trees, and unless removed by drainage will surely "water-log" the land; hygroscopic water is an inconsequential quantity too small to be material, cultivated plants being entirely dependent upon capillary water for growth.

The power of a substance to absorb by capillarity is seen by placing one end of a soft cloth, or blotter, in liquid, the whole material soon becoming saturated; in soil this quality is most plain when brick, or partially decayed wood, is buried, for moisture continues therein long after the surrounding soil has thoroughly dried. If spaces between soil particles are too large, as in coarse sand or gravel, capillarity is impaired, for water cannot remain suspended between such particles by their attractive action; while if clay is so packed that the spaces are closed, which ordinarily exist between the minute particles, water percolates slowly by reason of its impervious nature, and not from inability to attract by capillarity.

When the moisture content exceeds the capillary capacity of the soil, the whole quantity becomes gravitational, and is not in condition to maintain plant life until the excess passes off. Our scientific investigations have not shown if this result is due to the dilution of soil solutions until too thin to sustain life, or if from want of aeration, or whether plant stagnation takes place at this point by reason of noxious denitrifying bacteria, there being con-



The cut illustrates how particles of sand (magnified) can be so mixed with humus that otherwise sterile soil is built up into a fertile condition. In this way organic matter becomes useful to conserve moisture and prevent too much circulation of air.

flicting theories about the causes. But we all know that orchard trees will soon die if gravitational water envelopes their roots. Then the problem of drainage is primarily to provide an outlet for gravitational water, as well as to enlarge the capacity of the soil to hold capillary water—that important quantity which should be conserved by all reasonable means.

It must not be doubted that for sub-drainage purposes humus is essential in heavy soils. The following table is compiled to graphically illustrate this truth:

Kind of soil.	Water percolation in 12 hours.
Clay	1.10 inches
Silt	16.82 inches
Sand	118.91 inches
Humus	193.40 inches

Clay loam is admittedly the best soil for fig trees, but it should receive liberal additions of humus from cover crops, or manures. Compared with other soil matter humus absorbs water like a sponge, moisture soaking from fiber to fiber, part to part until all is rapidly filled. The above table states facts about capillary water; gravitational water passes through sand in a short time. A combination of clay and humus has those qualities which distinguish it as an absorbent and the best texture for moisture retention.

But if there is a high content of humus, moisture passes off the surface more rapidly, for the same reason that it percolates so quickly. Its percolation is due to capillarity, not to gravity, and that movement is most active in earth containing much organic matter; notice how much faster a sponge dries than substances of closer texture. Capillarity is that power which lifts water from part to part in a natural effort to maintain a pressure equilibrium, and as the surface dries the supply rises readily from below. This process is continually going on underground; as fig roots drink that close by, removing it to branches, the quantity around them is constantly reduced, and the rapidity of their growth is dependent upon prompt renewals by spongy organic matter. If soil is impervious—as most new prairie ground—the supply is recuperated slowly and all movements of tree life are proportionately deliberate. In making fifty pounds of wood ten tons of water is consumed and expired by the leaves. If gravitational water percolates through clay at the rate of one foot a week, how much more slowly must capillarity act in bringing a supply to root ends when the only impelling force is the change of underground pressure caused by absorptions through the membranes of microscopic root tips. Add humus to clay soil and it is made spongy and increases the activity of every plant produced. Alone, clay is difficult to work into a pulverized top layer, but with organic matter abundant, it makes the best surface mulch, readily transmitting moisture from above and satisfactorily conserving that below.

The most efficient method of building up the storage capacity of the soil is to drain it from beneath. All other material for that purpose has given way to tiles, that being the cheapest and most efficient. Sub-drainage will lower the level of gravitational water to the bottom of the tile bed, the depth of capillary water increasing the same distance. If soil is "water-logged" eight inches below the surface there can be neither aeration, nitrification nor ordinary root growth below that point, vegetation penetrating such subsoil with great difficulty. By putting tiles two feet underground the water table descends to that depth, giving three times as much—three times the ground in the farm.

After drainage the most practical and efficient aid in soil building is growing leguminous crops. Even among established trees they condition subsoil cheaply, for nitrogen gathered by legumes from atmosphere is deposited below the strata of ordinary fertility where most needed; and after the legumes die each rootlet readily decays, leaving a porous thread for water and air to continually circulate downward. The most beneficial rains come in showers during growing seasons, and such decayed roots provide organic matter to retain much moisture where it falls.

Mulching is receiving unusual attention at the present time, and is described in another chapter; it promises at no distant day to modify some of our most fixed methods of horticulture. Whether this means of conserving moisture and supplying nitrogen will be available to fig growers is problematical; at least there are serious obstacles to its use, for, under a mulch, the trees have such a tendency to develop shallow roots, at the expense of deeper growth, that nematodes ravaging near the surface, where ground does not freeze, so greatly injure them that a general application of mulching should not be attempted until experiments have demonstrated its value in each locality. Young trees should certainly receive no mulches until their lower roots are considerably developed. But realizing the remarkable stimulation that is given almost every plant by shading the ground, thus improving both the quantity and quality of fruit, this work should continue in the expectation of finding some practical way for its beneficial application to these trees.

CHAPTER XVII.

WIND-BREAKS.

Bailey describes four harmful results and thirteen benefits from wind-breaks. A careful orchardist often shelters his trees by protection that avoids injury without losing the advantages. Adam says the best wind-break is another row of trees. An orchard of several hundred acres needs none: "The outside row acts as wind-breaks." Tall growing varieties of fig trees are sometimes selected as wind-breaks for other vegetation.

If a farmer will have one, let it be a kind that interferes the least with atmospheric drainage, and that will not be a breeding place for noxious insects and harmful fungi. Some contend that wind-breaks should entirely surround orchards in order to lessen the effect of breezes that enervate trees by alternately bending and releasing the limbs from atmospheric pressure, their vitality being expended in the effort to recover upright positions. But theories of this kind will not be discussed, as it would extend our work beyond the scope of a field manual into less substantial considerations.

Among writers the prevailing opinion is certainly in their favor. Of Bailey's thirteen benefits but three apply to fig growing: "1. A wind-break may protect from cold. 2. Reduces evaporation

Fruit Trees are protected by Wind-Breaks on the Western Plains.

from the surface of the soil, tending to mitigate drought in summer and root injury in winter. * * * 13. It can be made an ornament." To these three a fourth may be added: A good wind-break along the east side of the orchard modifies the warm rays of morning sunshine, allowing a frosted tree to thaw slowly and avoids checking and splitting of bark that follows when the sun shines directly upon injured parts.

As protection from cold, a wind-break has doubtful utility, its value being only during freezes, as distinguished from frosts. In frosty weather the effect is to lower temperature around it by holding cold surface air in check. The fig not being grown in latitudes where there is extreme cold, during wind storms it is not beneficial. Where raised on a commercial scale injurious freezes are infrequent; there having been but seven, since 1860, along the Gulf Coast. When the infrequency of cold weather is considered, although they retard falling temperatures a few degrees, it should be remembered how detrimental they may become as harbors for insect pests, and fungi, and the habit of the trees in making sizable new wood to which the fruit is directly attached, abbreviates their principal general use. Limbs a month old are often three-eighths of an inch in diameter, and well able to sustain foliage and crop. There are no fruit spurs, for each fig is attached to a limb at the axil of a leaf. If not too ripe for preserving no wind will whip it off

A Wind-Break Needed.

without destroying the top, and only a very severe storm will cause any fruit to fall. The season of high winds does no damage, as there is nothing on the trees.

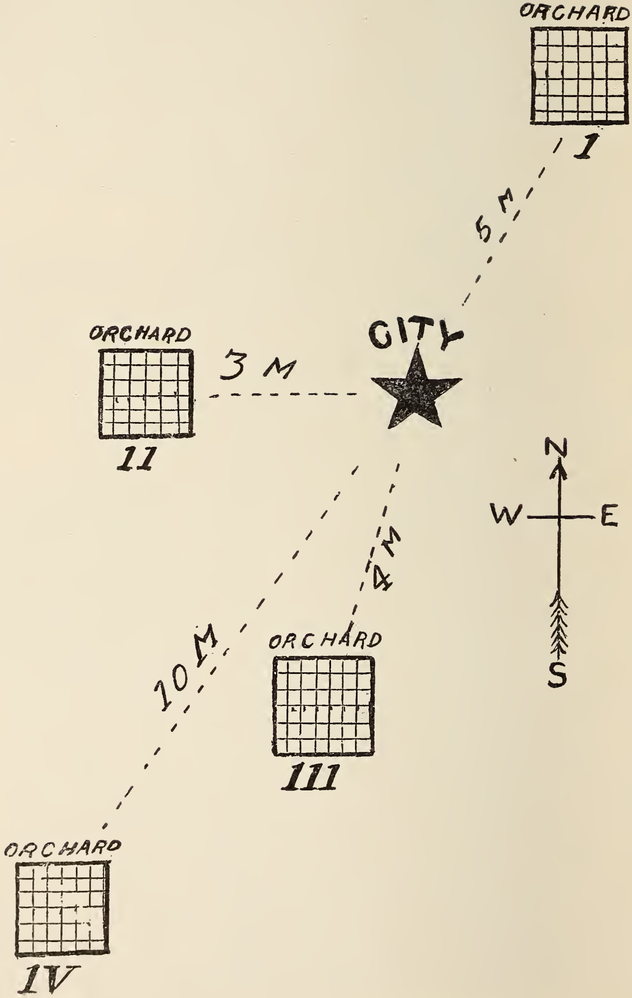
Evaporation may be considerably checked by a good wind-break. In the Southern fig belt this is of little consequence, for the prevailing breeze is laden with moisture. But winter winds are peculiarly drying—a pond evaporating more in one day during a clear norther than in a week of quiet sunshine. How often has a new fig orchard died to the ground, supposedly from frost, or the shock of pruning, when it was merely the result of wood evaporation during the interval between early pruning and spring growth. Even uncut limbs lose vitality in winter very largely from evaporation through the bark, especially if the stored strength of the top is reduced by intermittent warm spells of incipient growth. To so handle an orchard that the trees will not thus waste their vigor requires a thorough knowledge not only of wind-breaks, but of the essential principles of horticulture, and botany, and clear discretion in field work.

The most desirable wind-breaks vary in different places with their uses. The Californian protects his orange grove with eucalyptus trees from fifteen to seventy feet in height, or with cypress hedges that grow thirty feet and have as great a spread. In Manitoba, and the Northwest, wheat is sheltered

In New England the stony farms furnish material for walls which act as wind-breaks.

by low artemesia hedges. In New England stones are piled in walls along boundary lines, forming the farm fences as well as efficient wind-breaks. In parts of the Central States the Siberian poplar is in favor for that purpose. Near the Gulf of Mexico trifoliata orange hedges about fifteen feet high give ideal protection.

Our academical abstractions about the scientific value of wind-breaks sometimes receive rude shocks from the irresistible logic of facts. An instance of this kind occurred during the freezes of 1909. At a certain place the following observations were taken: Before daylight on January 11 of that year the temperature was about 73 deg. F.: at 3 p. m. the same day it was 34 deg.; at 7 p. m. 30 deg.: at 2 a. m. on the morning of January 12. it stood 22 deg., from which time, rising very slowly, it passed the freezing point about 8 o'clock a. m. January 13. Now what effect did this wave have upon protected and unprotected trees? The treatment they should receive to shelter them from cold belongs to another chapter; so, also, their subsequent care when injured. But the question is: Did wind protection lessen danger? As usual this freeze was accompanied by a stiff breeze from the northwest. Within a radius of a few miles there were four orchards of some size at each of which the foregoing temperatures were recorded, three of them being exposed while the fourth was well sheltered by a wind-break. The following sketch will indicate the relative location of each orchard:


ORCHARD
I
5 M
ORCHARD
3 M
CITY
II
N
W
E
S
4 M
10 M
ORCHARD
III
ORCHARD
IV

Orchards I, III and IV were upon open prairie with no more obstruction to windward than the barbed wire fencing which surrounded each. Orchard II was enclosed on the north and west by a dense growth of pines, and hardwood trees, many of which were thirty feet high, with an impenetrable undergrowth of bushes and vines—an ideal wind-break, for the fig trees extended only ten rows wide in a strip along this young forest. All four orchards were in good tilth. But did the wind-break justify expectations? Not here. Did the sheltered trees get immunity? Not at all; to the contrary those which nestled so safely in the lee of the forest were frozen back from four to eight feet, some trees having to be cut to the ground. The one four miles south called Orchard III was blighted to a less extent, while Orchards I and IV entirely escaped injury.

So the wind-break, evidently, did not mitigate the damage; but this fact does not argue against them generally, for other stronger influences caused the sheltered trees to be the greatest storm sufferers, their susceptibility accounting for results rather than the exposure. Orchard II had light soil; the sandy, dry ground absorbed considerable heat during the preceding week, and it had radiated and reflected warmth about the tree tops. This mild atmosphere had started the sap, the leaf buds were all swollen, some were opening, thus being wholly out of winter condition, and peculiarly exposed to the ravages of the storm. Trees in the third orchard were active though not so far advanced as in Orchard II, but sufficiently to account for their lack of subsequent recuperation. The other two orchards were practically dormant; the clay loams of each, being moist, responded more slowly to the warmth of the sun, and radiated very little heat, while refraction was reduced. It would be a strain upon the imagination to think that an envelope of warm air is ever created over clay soil for more than a few hours at a time during the winter season, and without heat there is nothing to induce buds to swell. Botanists tell us that the initial growth of a cutting, as well as a tree, is always from the action of heat upon starch cells stored in the top branches—not from root activity—and this tendency to sprout appears at any time during winter, or spring, when the enveloping air is continually heated to a degree comfortable and inviting to the plant.

A month after the freeze just referred to a second one occurred in the same locality, the temperature falling to 21 deg. F. This time Orchards II and III were active again, and the entire top growth was ruined. Orchard I was just about to start, leaf buds being swollen, and wood less than two years old was injured. Orchard IV, though but a year from the nursery, was uninjured; between the two freezes it had been transplanted into a new ground formation, keeping the trees entirely dormant. Therefore, the activity of sap as affected by soil, moisture and temperature is potent in inviting their destruction, and becomes more important than hedge protection as a practical problem upon the farm.

CHAPTER XVIII.

ATMOSPHERIC DRAINAGE.

In the flat coast country atmospheric drainage is of very little importance. Generally its effect is two-fold: cold currents are deflected from higher ground, but, being held in the locality of the obstacles placed for their hindrance create a lower temperature around them. Where there is sufficient slope to allow currents, which hug the earth, to drain off on lower lands, a white frost is often entirely avoided; but wind-breaks. though mitigating the seriousness of freezes, so hinder surface air during still nights that the lowest temperatures are found in their lee just where we ordinarily expect the most protection. Night currents keep close to the ground, moving independent of wind pressure, and, being cold, seek the lowest places. Their movement is often two to six miles per hour, notwithstanding the air appears practically still. Instruments designed for measuring this motion indicate its existence practically all the time. No adequate idea of the importance of these movements can be realized without keeping in mind that atmosphere is a very poor conductor of heat; were it not that heat sets air rapidly in motion it would be the only substance used for insulating all cold storages. Discolor a current and watch while its temperature is taken at different places and interesting illustrations can be seen of its activity and temperature. Who has not noticed that along the slopes of foot-hills there is an interval of ground immune from spring frosts which create havoc on higher altitudes, as well as in the valleys; and in riding over country we invariably notice chilly air in the depressions.

If a fig farm slopes naturally to lower ground a prevention of atmospheric drainage would be injurious unless placed upon the highest boundary ridge to deflect colder air from the outside; even then it would probably encourage frosts instead of mitigating them. If an orchard is in a depression from all sides the more it is protected the better, for, in such cases, cold air accumulates around the trees during every still night. Such causes frosting of tender limbs whenever the atmosphere falls within two degrees of freezing, for evaporation goes on so rapidly from the surface of new leaves that its process reduces temperature at least two degrees lower than the surrounding air, this being a potent reason why new growths are most susceptible of injury.

CHAPTER XIX.

MULCHING.

Among horticulturists there is a decided tendency toward liberal mulching of orchard trees usually in connection with cover cropping. The theory of mulching is generally misunderstood, and many who try this method of tillage often fail to apply it with sufficient care for tests to be fair, or successful. It has been employed satisfactorily in Ohio since 1879, and apple growers in New York have adopted it for more than thirty years with excellent results. Throughout the Southwest Stringfellow has been its herald. At the experiment station in Oklahoma remarkable increases in crops have thus been made; the Georgia, Nebraska and Wisconsin stations endorse the practice; at Geneva the State station has been conducting the most elaborate comparative tests in order to definitely elucidate results in detail, and the Ontario station commends it to Canadian farmers. It is an application of one of nature's methods of conserving moisture, building soil and promoting decomposition of organic matter; for do not forest leaves and blighted grasses furnish virgin soil its principal source of recuperation? Who has not noticed the marshy character of grass lands in winter while cultivated ground alongside has been dry? Green and Ballou state in

The Forest floor is a perfect mulch of leaves and twigs, replenished from above each season as the under layers decay.

a bulletin of the Ohio station the leading ideas in its use: "There should be a clear conception in the mind of anyone who thinks of attempting the grass mulch method, as to what it means, for failure is likely to result if it is not properly carried out. It does not mean the turning of an orchard out to grass, and allowing the trees to struggle with all sorts of adverse conditions. It is not a slipshod nor a lazy man's method. It has not been invented in order to save work. It does mean storing up of humus while the orchard is young, or possibly before it was planted, for its use in old age, like the setting aside of a reserve fund to be drawn upon as needed."

"The notion that the soil of an orchard can be clean cultivated for a number of years until the vegetable matter is nearly all destroyed, and that it may then be restored in sufficient quantities, by growing cover crops, is a wrong conception." "For there must come a time when it will be impossible to grow sufficient crops under the wide spreading branches to keep up a supply of the much needed humus." The mulching plan "insures the greatest possible quantity of humus during the entire life of the orchard. Theoretically a soil thus filled with vegetable fiber ought to contain plant food in abundance and to have a water holding capacity sufficient to supply the needs of the trees at all times." "Mulches promote the formation of nitrates, and the healthy appearance and long retention of the foliage in autumn of grass mulched trees, indicates a sufficient supply of nitrogen. Doubtless, however, it is the uniform and abundant supply of moisture which counts for more than anything else.''

''The first effect of a heavy rain is the conservation of moisture by the prevention of evaporation of water from the soil of the area mulched. The surface of the soil is kept comparatively moist and the rapid decay of the vegetable matter, which lies in contact with this surface soil, not only provides accumulating humus and plant food, but the chemical and bacterial action in the soil beneath, favored by the soil covering, and its decomposition results in the liberation of mineral elements of plant food and the formation of nitrates that otherwise would not occur, or would be so slow as to be of much less immediate benefit to the growing trees.''

Orchards are usually mulched by mowing grass, which is allowed to grow between the trees, and piling it about six inches deep around each for a radius of several feet, replenishing it about three or four times each season. It is not efficient if less than six inches deep, and eight inches is better. The mulch is sometimes hauled from other lands and similarly placed about the trees. It smothers all vegetation underneath, furnishing such favorable feeding ground for tree roots that they develop into clustered masses, even entering the lower

The best apples are produced on soil tilled by cutting sod grasses three times a year, and piling it around the trees as a mulch. This treatment is not so successful when the trees are old.

layers of grass. The station demonstrations show that when applied to apples, plums, cherries, grapes and pears the yield of fruit is not only increased but its quality is improved, the size of each specimen is enlarged and the growth of wood and leaf is stronger. Experiments are in progress with other fruits, and no reason is anticipated why it should not be beneficial for fig trees; for most domestic trees have their roots partly protected by buildings, and are indifferently mulched with yard litter, both top growth and crops exceeding that in tilled fields. It has been objected that mulching causes a greater development of surface roots where nematodes easily attack them. This is true, being the principal objection, aside from the danger of fire in a completely mulched orchard; but, as yard trees yield large crops notwithstanding their roots are usually completely infested with the eelworms, it must be that mulching, even carelessly, encourages growth to the extent of overbalancing the damage of these parasites.

CHAPTER XX.

COVER CROPS.

The improvement of orchard soils with cover crops is one of the most important operations of fruit growing. This is the practice of raising grains, grasses, legumes and garden truck between trees with the primary object of improving the condition of the soil rather than for direct profit. In the Rocky Mountain States it is done, says the director at Fort Collins, as well to protect the ground from injury by direct sunlight as to add nitrogen to the soil. Throughout the North Central States the practice is quite thoroughly established, cultivating the ground until midsummer, and then growing legumes until frost, as they make a mat during winter and add much humus material when plowed under in spring. Every experiment station in these States has adopted this as a cardinal method for maintaining soil in good texture, and there is not a dissenting opinion in the New England stations as to its beneficial effects. Winter cropping has become quite general among the fruit growers of the Pacific Coast where clean cultivation usually continues until frost, and then a winter growth—usually a vetch or field peas—is planted until spring and plowed under. In the South cover crops are steadily gaining favor, for orchards continually

Erosions from heavy rains, the fertility having been washed away to bottom lands ; easily prevented by the use of cover crops.

increase their consumption of plant food while the natural supply gradually diminishes as tops spread and roots occupy more and more layers of surface soil. The cost of seed is inconsequential, compared with tilling fields every ten days when cultivated clean, and it is probable that methods will gradually be perfected for use in connection with mulching, materially reducing field expenses. Fig trees ordinarily require such constant tillage to obtain profitable crops that treatment lessening such work without impairing results will greatly stimluate the industry. Mulching liberates plant food in the soil as readily as by clean cultivation, being less expensive, and supplies large quantities of organic matter; and can be satisfactorily restored with cover crops as it decomposes.

Although cover cropping for soil improvement was practiced in Ohio as early as 1879, probably the first methodical tests were made about twenty years ago among apple orchards of Central New York. Since that time it has been used wherever fruit growing has received careful study, having found favor for the following reasons: (1) Soil is renovated by growing some other plant than it usually produces; (2) it furnishes humus most economically; (3) if legumes are used soil nitrogen is increased; (4) the ground becomes friable and more comfortable for root growth. Other reasons could be stated until the list would be a long one, but with these four general results in mind different ad-

In Nature's Laboratory. Virgin growth is protected by a dense cover crop shoulder high, which replenishes a mulch often two feet deep.

vantages suggest themselves. It is as essential to maintain friable, moisture-holding, humus-forming texture as to plant healthy trees, these considerations applying in fig culture with peculiar force.

There are dangers from cover cropping, such as the consumption of moisture and plant food at times when needed by the trees; but these are avoided, in cool climates, by planting in the late summer and fall, and, in the South, during the fall and winter. Thus trees are furnished all the moisture and fertility of the land during the season of strong growth while the late crops restore that which has been consumed in time for the next season's use. This system is an adoption of Dame Nature's methods. Were it not for the fertility from decaying grasses and leaves deep rooted vegetation would not only find sterile ground for falling seeds, but the chief source of its own vitality would be lacking, all virgin growth rapidly disappearing. Cover cropping is an improvement of natural methods which sustain plant life in the wild, and, having prevailed since the beginning of floral growth, it has been the largest factor in a slow evolution of uncultivated vegetable species.

It is difficult to find sound objections to the use of cover crops; if not grown during seasons when trees need all the soil food results are entirely beneficial. In floral history lichen preceded grass, grass prepared the ground for deeper growing plants,

At Hermosillo, Sonora, fruit trees are cover cropped with morning-glory vines and grasses, which are allowed to grow during the fall and winter, to be turned under in the spring.

weeds and shrubs each in turn making possible the formation of larger root systems further below the surface. The modern farmer returns to this process when plowing under a crop of green manure, there being, however, this difference: in two or three years he thus restores a worn out soil, while natural processes occupied centuries of slow improvement to obtain less definite results. He does little more than nature accomplished, except by better methods. When moss decays in spring one crop is converted into another; and when stable manure is incorporated in the ground a crop is transferred by the process to different parts of the farm, stock having wasted some and utilized a small quantity in making animal tissue; and in applying commercial fertilizers the fertility of other fields is simply concentrated in one's own.

These crops are as useful for fig trees as for any other plants. Their wood is large celled and succulent, the roots making probably twenty-five times the quantity of ordinary fruit trees in the same length of time. To supply this material, soil should not only be well drained and renovated, but the organic matter should be maintained copiously with abundant nitrogenous food. Fertility is not only obtained economically from green manure, but the land is left more friable and open for root development by the fining of soil particles. Roots produce top growth, furnish fruit, make incomes, result in

Showing how badly-washed land may be reclaimed by growing green manure between the trees.

profits. A crop of legumes often adds as much nitrogen per acre as is purchasable in any other form for seventy-five dollars, and when thus supplied is most available for trees, changing so slowly into solutions that the best opportunity for assimilation is afforded.

Cover crops are ordinarily classified as leguminous and non-leguminous. Those of the first class have peculiar value, as they absorb nitrogen from the air, depositing it in small nodules underground, and even when top growth is removed the stubble and roots enrich the soil. In actual field work it is often desirable to mix the seed of two or even more kinds in order to occupy the ground a desired length of time, to smother weeds and obtain special results that could not be done by using one only. The following plants are principally used for these purposes.

Non-leguminous.

Alfilaria.	Millet.
Barley.	Oats.
Broom Corn.	Rape.
Buckwheat.	Rye.
Corn.	Sorghum.
Emmer.	Spelt.
Grasses.	Turnips.
Kaffir Corn.	Wheat.
Kale.	

Legumes.

Alfalfa.
Beggar Weed.
Berseem.
Bur Clover.
Canada Peas.
Common Vetch.
Cow Peas.
Crimson Clover.
Hairy Vetch.
Horse Beans.
Japan Clover.
Mammoth Clover.
Peanuts.
Red Clover.
Soy Beans.
Sweet Clover.
Tangier Peas.
Velvet Beans.
White Clover.

In selecting a cover crop it is necessary to bear in mind the peculiar qualities and habits which make one rather than another preferred for particular purposes, giving due consideration to that care which each requires, the soil and conditions promoting growth, the length of time for maturity and the seasons and temperatures most suitable; therefor, these characteristics of the following crops, applicable when used in fig orchards, are given as briefly as practicable:

ALFILARIA.

"Of the introduced plants (in the Southwestern States) alfilaria, also known as alfilerilla, filaree, pin clover, is so well adapted to the prevailing climatic conditions and has proved itself of such great value as a range plant, that it is considered as ranking first in merit." (U. S. Bull., 267.)

It grows from November until June, slowly forming a rosette in winter, stands frosts, and has a strong tap root which acts well upon the soil. The main objections are slowness of development, the top not forming until spring allows the orchard to become weedy.

BARLEY.

Among more than fifty varieties most of them are frost-resisting. It withstands any weather where figs will grow, chokes weeds, prevents leaching and washing, and improves soil texture. If planted early in the fall considerable stalk can be turned under in March, but large quantities of green matter tends to sour the soil, for which reason it should be in milk before using.

BROOM CORN.

This plant can be well used for a fall cover crop, as it makes a rank growth, producing much coarse top that can be plowed under to advantage, and effectively kills all weeds.

BUCKWHEAT.

Of the three varieties in the United States all require a cool climate. Buckwheat withstands light frosts, but seldom survives ordinary winter weather as far north as New Orleans. A crop matures with difficulty, the flowers being killed by either a frost or a warm wave. "Buckwheat will mature in a shorter period than any other grain crop, eight or ten weeks being sufficient under favorable conditions, it is thus well adapted to high altitudes and short seasons." It leaves the ground in a peculiarly well pulverized condition, and the large tap roots go into the subsoil. (Corn. Bull., 238.)

CORN.

Sown broadcast corn makes a dense ground covering, and although it consumes more fertility and moisture than any other grain, the after effects are beneficial when plowed under. Its habits are well understood.

EMMER.

Emmer resembles wheat in habits, appearance and grain. Its capacity to thrive on poor soils and the shortness of the growing period commend it as a superior cereal. Varieties now being produced will undoubtedly survive winter weather as far north as Wisconsin. It will "make a good crop with almost any condition of soil or climate." (U. S. Bull., 139.)

GRASSES.

A number of horticulturists have devoted many years to the study of orchard grasses for cover crops and mulching. Some of their work is described in bulletins, the record of fruit yields and tree growth arguing that a new chapter is thus opening which will increase production and greatly reduce field work, as discussed elsewhere. Among them are Red Top, Timothy, Brome, Bermuda, Teosinte, Guinea, Mexican Clover, Orchard Grass, Fescue, Oat Grass and Kentucky Blue Grass.

These "protect the surface of the ground from the scorching sun in summer and from washing rains in winter, and add to the fertility of the soil by providing humus." (U. S. Bull., 300.)

KAFFIR CORN.

These plants shade the ground well, crowding out weeds, providing large quantities of organic matter and fining the soil. "The Kaffir Corns are non-saccharine varieties of sorghum." (N. J. Bull., 158.)

KALE.

"Thousand-headed kale has been grown in the Willamette Valley for twenty-seven years, is now rapidly becoming a very popular fall and winter soiling crop. It stands the mild winters west of the Cascade Mountains admirably." (Ore. Bull., 91.)

MILLET.

A hardy, rapid growing plant adapted to a wider range of soil and climate than peas or oats; useful for renovation. "An excellent thing to grow on

A Cover Crop of Oats and Vetch.

foul land to get rid of weeds, giving pratically the same results as summer fallowing, or summer cultivation." (U. S. Bull., 101.)

OATS.

Useful as a cover crop to add humus smother weeds, prevent leaching and to fine the soil. It withstands frosts and light freezes if not "in the boot," and will recuperate when injured. The period of growth is too long for winter use.

RAPE.

Rape resembles a turnip, or ruta-baga. Its action on the soil is similar to that of buckwheat, and withstands the Southern winters. It draws moisture and fertility almost as heavily as corn, but improves sod ground rapidly, and will grow upon swampy lands. "Rape seed is mostly imported, but can be grown in the Middle South and certain localities along the Pacific Coast." (U. S. Bull. 164.)

RYE.

This plant is quite delicate when young, but grows all winter in the South. If sown early in the fall ripens in time for spring plowing, but slow growth permits the ground to become weedy. It does well on a greater variety of soils than any other of the common grains, and is a favorite for the renovation of worn out lands.

SORGHUM.

Sorghum draws greatly upon the soil. It chokes noxious weeds, shades the land, and produces abundant humus making substance. "It resists drought better than any other succulent forage crop." (Neb. Bull., 84.) It is immune to nematodes and wilt or root-rot, for which reason in several seasons will starve the eelworms, and fungi, if other vegetation is subdued.

SPELT.

An importation from Russia, having habits similar to emmer and wheat. It grows well on thin soils and at least one variety resists the coldest weather of this country. It resembles wheat and is useful in arid regions. "Their ability to resist drought is remarkable, in spite of the fact that they are mostly spring varieties." (U. S. Cir. P. I., 12.)

TURNIPS.

This vegetable withstands winters in the South, adds large quantities of moisture and humus to the soil and protects from leaching.

WHEAT.

More than thirty varieties are frost resistant; they all improve tilth, prevent leaching and smother weeds.

ALFALFA.

Probably the most important of legumes, but not adapted for orchard work. Its initial growth is very slow and delicate, not competing with weeds, and when established consumes large quantities of moisture at seasons needed most by trees.

BEGGAR WEED.

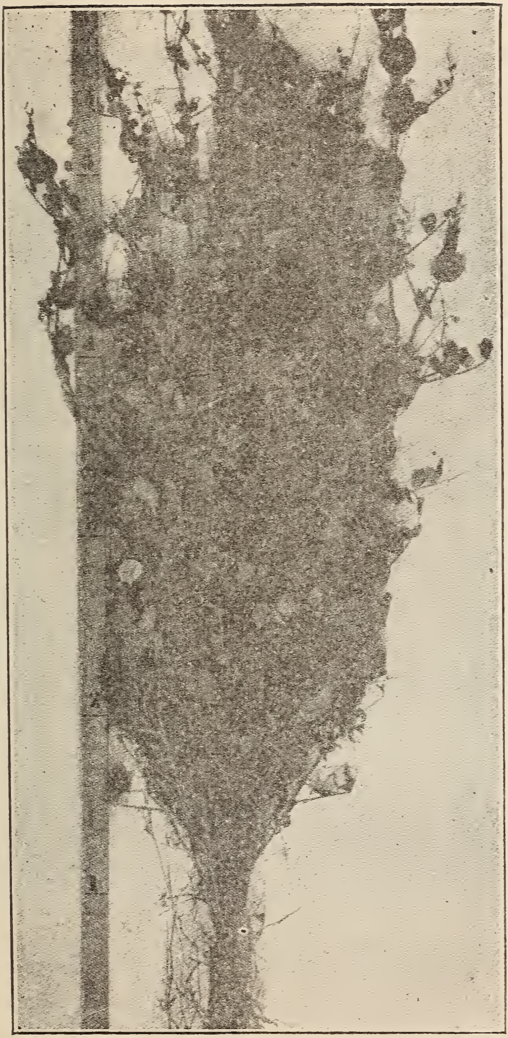
This West Indian legume makes a rank growth and can be successfully used as far north as Nebraska. (Neb. Bull., 84.) "Not only does it gather nitrogen from the air and enrich the soil with it, but, by means of its long roots it penetrates soils to considerable depths in search of food and brings it nearer the surface. It cannot be too highly commended as a renovating agent on worn out, sandy soils." (Fla. Bull., 43.)

BERSEEM.

Berseem has habits about like red clover. The slowness of development precludes use on weedy lands. It stands frost well, materially improves the texture of the ground and can be used with advantage as a winter cereal.

BUR CLOVER.

This annual is of the highest value as a winter cover crop. Aside from slow growth, the habit of all clovers, it ranks among the best; 23 deg. F. does



Top Growth of a Frost Resisting Variety of Field or Canada Peas.

not injure it, and the long creeping vines, with roots at every joint, grow at least four feet in good soil, making a dense covering. It develops slower in warm weather than at winter temperatures, and is especially useful in high altitudes. "This plant is gradually taking the commons and roadsides at many places in Texas, growing on all grades of land from the poor sands to the stiff, black, waxy lands." (Tex. Bull., 108.)

CANADA PEAS.

In our introduction we have given several opinions about field peas. As crops mature in three months of mild weather, resisting 23 deg. F., and growing well on as great a variety of soil as oats, it is peculiarly adapted for winter cover cropping of fig orchards. It deposits nitrogen about like cow peas, rotting readily when turned under. There is difficulty in maturing seed as the flowers fall when frosted. In Southeast Texas during the winter of 1909 the Golden Vine was killed to the ground twice, but later sprouts matured a good crop.

COMMON VETCH.

Oregon, or Common, Vetch grows slowly, but continues through the winter unless the temperature falls below 28 deg. F. It will withstand much colder weather without being destroyed. Where sown upon ground that is not weedy, or with a winter

Cow Peas and Kaffir Corn, mixed.

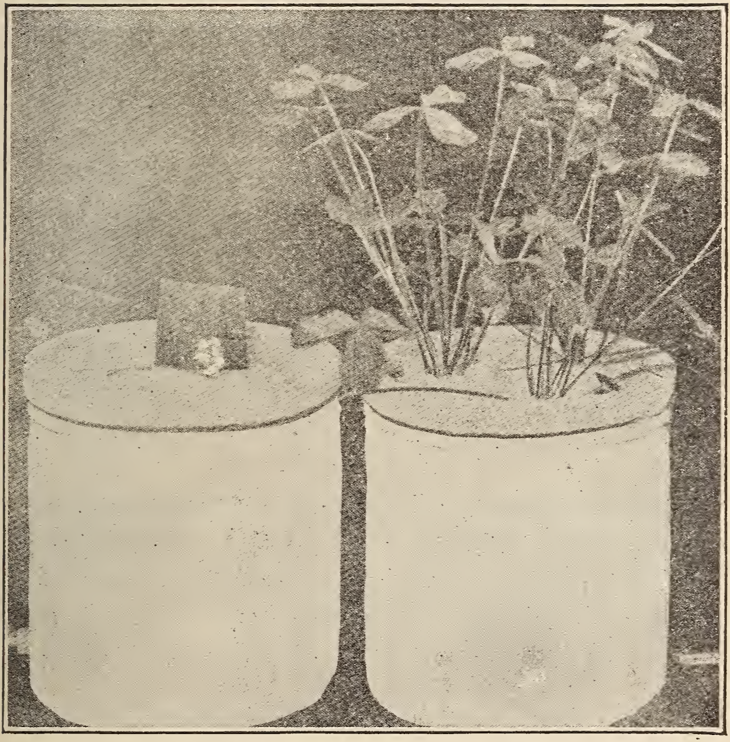
cereal, is very beneficial. Planted in September it is in fair condition to plow under in March.

COW PEAS.

Cow peas are the standard cover crops in the fig districts of this country, during warm seasons. Among more than thirty varieties the Iron should be used, being immune to nematodes and root-rot. Some varieties tend to climb trees, while others bunch, or bush. Their action upon the soil is so well known and so fully described in the rural papers as to require no discussion.

CRIMSON CLOVER.

"An excellent annual for the Middle South, but not hardy in Nebraska." (Neb. Bull., 84.) "There were planted side by side on August 1, 1906, three plats of clover, one of crimson, one of common red and one of mammoth. The soils were gravelly and porous. The crimson clover made far more rapid growth in the fall than did the others. All clovers wintered well, but in the spring the freezing and thawing killed nearly all of the crimson clover. It had, however, served its purpose as a cover crop." It deposited more nitrogen in the soil than any other variety tried. (Corn. Bull., 135.)



Clover was planted in these two jars at the same time. The difference in growth is due to soil having been innoculated with nitrogen-gathering bacteria in the right-hand jar.

HAIRY VETCH.

"This legume was found to be resistant to cold, heat and drought; occupied the ground during the fall, winter and spring; decayed rapidly when turned under; and enriched the soil by its ability to 'fix' or utilize atmospheric nitrogen when properly innoculated—that is, when the bacteria were present to cause the formation of root nodules." (U. S. Cir. P. I., 15.) Although requiring about six months to attain heavy growth, it has great value for winter use, withstanding lower temperatures than common vetch, but maturing more slowly. Most fruit growers prefer the other variety where the prevailing winter weather is not below 20 deg. F.

HORSE BEANS.

Although this is a staple forage plant in Europe, called there a common field bean, very little trial has been made in the United States, but successful experiments suggest its further use.

JAPAN CLOVER.

"It makes a better growth than any other plant on poor, barren clay soils. It quickly takes possession of uncultivated fields and holds them from washing and protects them from the hot sun." (Ark. Bull., 36.) Japan clover is better known as Lespedeza.

MAMMOTH CLOVER.

Although this legume stands low temperatures with less success than several other varieties, the enormous growth of coarse humus making material is valuable, and the roots thoroughly pulverize the soil.

PEANUTS.

This legume is almost as useful as an orchard cover crop as it is valuable for direct profit. Of the many varieties the Spanish is adapted to a wider range of soil and conditions than any other. "This variety has been observed to make a good growth and give profitable returns wherever the cow pea can be grown with success." (U. S. Bull., 227.)

RED CLOVER.

"The renovating character of a crop of red clover is well known, and even when only the stubble and roots are the source of the additions made to the soil the improvement which follows is very marked." (Penn. Bull., 102.) It is destroyed by hot weather and requires about six or seven months to make a valuable top growth.

SOY BEANS.

"This plant resembles the cow pea in many of its characteristics, namely, that it should not be seeded until the soil is warm." (Penn. Bull., 102.)

Soy beans are preferred to cow peas for cover cropping by an increasing number of farmers. The cut shows a field ready to be plowed under, the vines being ripe enough to avoid souring the soil and sufficiently mature to add many tons of organic matter. Actual cost $6.00 per acre plowed under.

"It is destined to become a very important agricultural product in many sections of the United States, both as a grain and forage crop." (U. S. Bull., 289.) "Its great value as a crop has been clearly demonstrated." (U. S. Bull., 58.) "Soy beans are preferred to cow peas by an increasing number of farmers in the South." (U. S. Bull., 278.)

SWEET CLOVER.

"Owing to the ability of sweet clover to grow in the poorest of soils, it will probably be found of high value in increasing their fertility. The seed should be planted very early in the spring." (U. S. Bull., 278.) It is a biennial.

TANGIER PEAS.

This beautiful plant is rapidly increasing in favor as a cover crop among the citrus fruit orchards of the Pacific Coast. It is of rapid growth, choking weeds effectively, and makes a large yield of stalk, which decays easily, while the amount of nitrogen left in the ground indicates a high fertilizing value.

VELVET BEANS.

This legume is in some respects the most valuable of cover crops. Aside from a viny habit which renders it difficult to plow under, it compares favorably with the best varieties of cow peas, even exceeding them in deposits of nitrogen.

WHITE CLOVER.

An important forage crop which is very hardy, and especially useful upon poor soils liable to wash. Its growth is usually volunteer and continues until drought. While probably the first legume to maintain itself upon barren soils the tops are too small to subdue weeds.

CHAPTER XXI.

DISEASES OF FIG TREES AND INJURIOUS INSECTS.

We will not attempt to account for all the diseases and injurious insects which infest fig trees and fruit. Saccardo describes fifty-three fungi which attack the leaves, fruit and roots upon the European continent alone. Eisen adds a fifty-fourth: "In France the fig plantations suffer greatly from the attacks of a root fungus of the genus Rhizoctonia. The roots alone are affected, and are destroyed in a very short time." There is no record of these having appeared in the United States, and as abstract scientific treatises fully describe them we will discuss others which are troublesome in this country.

ROOT-ROT.

(Ozonium Auricomum.)

According to the reports of the Department of Agriculture at Washington, and the experiment station of Texas, the root-rot has attacked fig trees in the southeastern part of the State; and several nurserymen near the center of Texas describe a disease among their stock which strongly indicates its presence. It is a fungus growth interfering with sap circulation in the roots, and, spreading very rapidly, causes trees to quickly wither and die. The fungus is well understood by those farmers with whom the Department of Agriculture has been working to eradicate it from cotton fields during the past fifteen years. Comparatively few plants are immune; its ravages are seen among the ornamental trees and shrubs of the Capitol grounds at Austin, and the park at College, as well as at many other places, even primeval forests being in danger, as virgin soils contain the noxious germs. In general farming it is subdued by growing sorghum, or some other resistant crop in a rotation, as most of the germs are starved when provided with no acceptable food. The Department of Agriculture has not become committed to any particular treatment, though giving valuable suggestions, but several liquids evaporate beneath the surface of the soil, producing a gas deadly to animal and vegetable life, and these can be used satisfactorily, holding the disease in check. There are a number of compounds of carbon and hydrogen, any one of which may be introduced to an affected soil by burying saturated substances, dripping liquid in front of a falling plow furrow, pouring into a fissue made with a spade, or by emptying a measured quantity at the bottom of a hole made with a hollow crowbar, and if applied with sufficient care to avoid direct contact with roots the permeating gas destroys underground insects and fungus life for a considerable distance around. If too much is used close to a tree it will prove fatal, about an ounce at a place on three sides of the crown, in two applications ten days apart being efficacious. These solutions sell wholesale from ten cents to one dollar a gallon.

NEMATODES.
(Heterodera Radicola.)

The nematode is a microscopic, parasitic eelworm. It is generally found where the ground does not freeze deep, working upon the roots of many vegetables, cotton, grains, ornamental, orchard and forest trees, the soft, porous roots of figs affording excellent food. In sandy soil it sometimes goes down eight or ten inches, but in heavy loams four inches is the ordinary limit. Root enlargements usually first indicate its presence, these sometimes being mistaken for nodules on legumes, and are often so uniform in size and so regular in distances apart as to remind one of beads threaded on strings; but occasionally a single swelling becomes six inches in diameter.

The injury is done by interfering with the flow of sap—the circulatory life fluid of the tree. The cellular fibrous system becoming infested its continuity is destroyed and roots swell at points of infestation in vain efforts to provide adequate cells for normal circulation.

Numerous experiments have been made for the purpose of discovering means for controlling this parasite. The difficulty of treatment arises from the fact that being imbedded in the tissues of roots an application that will reach them comes in contact with fiber which it injured; and vapors and solutions which kill the insects have proven equally destructive to the host plants.

The work of this worm is described by Price and White as follows: "The fig seems to be especially susceptible to this injury in the moist soils of the coast country, where the damage is frequently considerable. * * * Over fifty species of plants have been known to be infested by this pest."

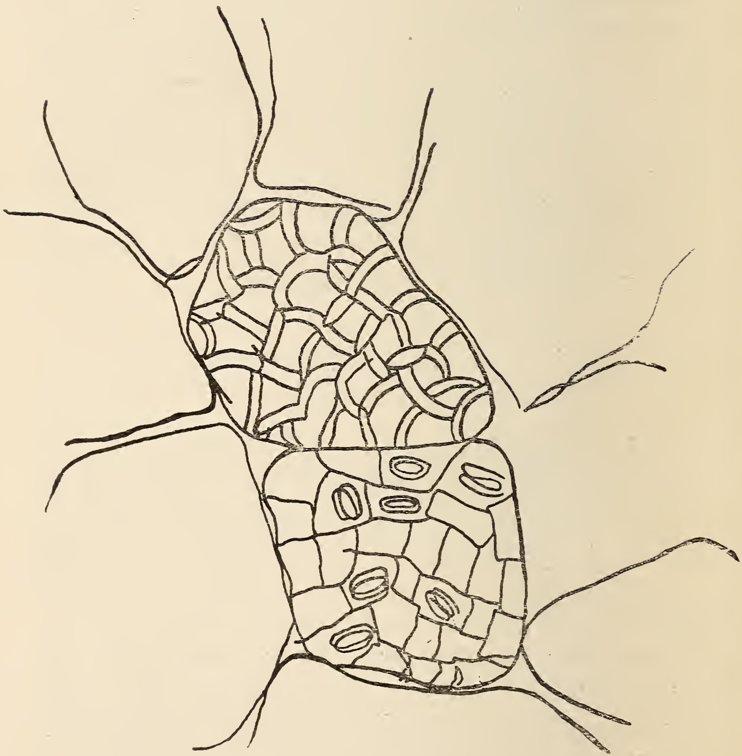
"It is not well to allow soil to remain in the greenhouse longer than a single season. It becomes somewhat exhausted and is likely to become infested with injurious forms of life, particularly nematodes, which cause root-rot. Most garden crops are attacked by this disease. Nematodes are not troublesome in the field except in the South." (U. S., Bull., 220.)

Tobacco dust, unleached ashes and lime tend to keep them in check. In Arizona the experiment station has used copperas water with varied results. Any solutions evaporating in the soil and leaving a heavy deadly vapor will kill them; but those now in use are equally fatal to trees. Nematodes work in damp places much faster than elsewhere, hence drainage assists in controlling their depredations.

The simple treatment is suggested of tilling the ground deep before planting or while the trees are young, so roots will develop far below the surface, the shallow feeders then being pruned in winter. Such pruning will stimulate deeper growth, and when done during warm spells of weather assists in keeping the tops dormant. An experienced fruit grower can trim the surface feeders around the crown with a sharp, narrow hatchet, without removing any soil, the blade communicating through the handle just what is going on below, and after learning the habits of these trees he can proceed very rapidly without danger of injury.

LEAF RUST.
(Uredo fici.)

This trouble has not assumed serious conditions until recently. It appears in round brownish dots on the foliage, closing the breathing pores and resulting in premature dropping of leaves. It is usually dormant until after the fruiting season, but the tendency now is to find it earlier in the summer. Growers are practically agreed that 5-5 Bordeaux mixture is an inexpensive and efficient treatment, not only holding the trouble in check, but eradicating it in two or three seasons. A glance at leaf structure will show how rust injures the plant. The accompanying cut is diagramatic only to illustrate the stomata, or breathing pores of leaves under a magnifying glass, and the cells which wither and



A Leaf Surface (magnified) showing stomata and cells.

close up when blighted with rust. Carbon and oxygen compose eighty-seven per cent of plant food, and these chemicals being absorbed mainly from the air through leaves their loss results in the rapid decline of the tree.

SCALE.

(Chermes caricæ.)

A large scale, about one-third of an inch long by nearly that width, has attacked fig trees east of the Mississippi River, injuring the foliage and resulting in dwarfed growth and stunted trees. It is easily distinguished by an oval shape and ash brown color. In May the young become active and spread over leaves and branches, where they work until late in August, then going dormant again. The lime sulphur wash has been applied with success.

FIG BORER.

(Ptychodes trivittatus.)

This insect is flat headed, about one and a third inches long, light brown with white stripes, one on each side of the body and one down its back, with wings, two long antennæ, a flesh colored mouth and six legs. It has the power to penetrate live bark with its horny mandibles, but rarely attacks a healthy, vigorous tree. Stunted or frosted ones are chosen and the beetle greatly hastens their destruction. Affected limbs should be pruned off, and if found in time the pests should be dug out with a knife or killed by injecting some deadly liquid into their holes. Numerous solutions are on the market from which one can be selected to exterminate them. "Fig growing in Louisiana would be a grand success were it not for the fig borer, which frequently destroys the trees." (La. Bull., 42.) Later bulletins from the same station deny the seriousness of this pest.

BEETLES.

Coleopterous insects puncture the skin and flesh of all figs, and while the commercial varieties are not ruined by them the fruit is impaired in appearance by the brown and white spots which result; many pickers calling such figs "pock marked." So rapidly do the bugs multiply that it is difficult to find unaffected fruit in any orchard late in the season. They suck an inconsequential amount of juice, which is diluted with a liquid first deposited near the skin, but it is impossible to make such figs into the best preserves without peeling them. As the beetles insert their proboses some distance before beginning to withdraw juice they cannot be caught with arsenical powders, or by spraying, and treatment necessarily consists in collecting the pests by bait, with a light at night, or in moss thrown on the ground, and killing them by hand.

CHAPTER XXII.

INJURIES TO TREES AND FRUIT.

FROST.

The best way to ameliorate frosting is to plant fig trees in heavy soil, clay loam being preferable. The first two or three years growth is not nearly so vigorous as in sandy loam, and clay lands require much more labor to bring them to an initial condition of tilth, but it pays. Every few days of warm winter weather the sap starts growing in trees on light ground, thus inviting disaster. It is not the warming of roots in periods of sunshine so much as the rapid rise of temperature of surface air around the tops, the result of radiation and reflection, starch stored in wood cells becoming active from heat and moving toward buds. "Fig trees are easily frosted, especially when caught by the frost with their sap in full circulation," said Eisen. On the other hand, their resistant power is evident, for even in the latitude of Washington and Paris, where zero weather occurs, continuous cold is not injurious. They are frosted oftener around New Orleans than in the vicinity of Memphis. The fitful Southern winters usually have periods of cool weather preceded by bright, warm sunshine for several days, sometimes for two weeks. If the orchard is in sandy ground no amount of root manipulation, or top treatment, can keep the trees dormant, and when sap is active a freeze is always disastrous. Some root prune to prevent tops from starting until spring. Such treatment, when done for that object alone, is open to serious objections, the vitality of the whole tree being thus weakened, and it is not an approved method of retarding initial top growth. Root pruning should be adopted as a last expedient, being questionable even then.

It is demonstrable by field experiments that the first sap movement of spring comes from vitality stored in limbs rather than the activity of roots. Botany teaches us: "The cause of the flow of sap appears to be the attraction of it by the leaves. The consequence of this is, that sap always begins to flow at the ends of branches." When buds open during winter it is usually from sap flowing in the limbs; thus in a fig cutting leaves are formed that vary in size with the quantity of wood, which unfold in advance of the formation of rootlets. Protect a forest log from drying during winter and branchlets will sprout so soon as the enveloping air warms to a temperature congenial for its growth, and though there are no roots, the leaves continue to flourish until all vitality in the wood is exhausted. Place a tent, or build a shed, over part of a fig tree, or, simpler still, draw some branches through a convenient window into a living room in winter time, the warmer interior air promoting growth until full sized leaves are developed, while exposed parts continue dormant. Sap moves in roots last, and great caution should always be used in pruning them.

Many years ago Lindley said: "When a plant is frozen the following effects are produced: 1st. the fluids contained within the cells of tissue are congealed and consequently expanded. 2d. Such expansion produces to some extent a laceration of the sides of the cells and impairs excitability by the unnatural extension to which the sides of the cells, if not lacerated, are subjected. 3d. It expells air from the aeriferous cavities. 4th. It also introduces air, either expelled from the air passages, or disengaged by the glacial decomposition of water into parts naturally intended to contain fluid. 5th. The green coloring matter, and other secretions, are decomposed. 6th. The vital fluid, or latex, is destroyed, and the action of its vessels paralyzed. 7th. The interior of the tubes, in which fluid is conveyed, is obstructed by a thickening of their sides." In a word, the cellular system is broken up, the protoplasm is freed and the lifeless branches rapidly lose their sap by evaporation.

In dry weather a fig tree will sometimes show injury at a temperature about two degrees above freezing, its tender branches being as succulent as tomato vines. This unusual sensitiveness, largely from the rapid evaporation which takes place through leaves and stems, is a factor in reducing temperature, the process of forming vapor extracting heat from new growth and contributing to its own destruction.

The frosting of a fig tree can be easily ascertained by examining either the wood or the bark. Frost darkens the cambium layer and it slips on the inner tissue. If wood is frozen brownish-red fiber can be seen, or it may be darkened all the way through. The only treatment is to prune back until affected parts are removed and milky sap exudes freely from each cut as made. If frozen to the ground most sprouts that come up in spring should be allowed to grow the first year and the following winter desirable ones may be saved. If the entire top is lost two successive winters there is little hope for healthy subsequent growth.

Many orchardists believe frozen sap is poisonous, and that unless promptly removed it will kill the whole tree. If true the fig is an exception among all perennial plants. Throughout the coastal region we can observe ''china berry'' trees that were in leaf at branch terminals when the February freeze occurred in 1909. Leaves that were frosted still hang to the limbs, and the extent of injured wood can be traced by its dark color about six inches back from the terminals, while from each bud brown fiber extends deep into the wood; yet, all the trees leafed out, so well as to entirely conceal the loss without pruning, there being no suspicion of toxic influences. Freezing breaks up the bark and wood cells, allowing it to dry very rapidly, probably before sap could move in a natural current. The human race is continually eating tons and tons of frozen fruit with impunity; every perennial plant from the grass in our yards to the largest forest trees habitually survive frosting; apricots, peaches, pears, plums, in fact all well known orchard trees are pruned in such cases, not to remove poisonous branches, but unsightly wood; and who has not seen healthy oranges and lemons sprout right up through dead, frozen tops?

The great susceptibility of fig trees to be injured in the South, the fact that they often show more resistance to cold at one time than at another, different parts of the same tree not being affected uniformly, indicate various results at one place that do not occur at another, as explained by Candolle's laws of temperature formulated many years ago:

1. All other things being equal. the power of each plant, and of each part of a plant, to resist extremes of temperatures, is in the inverse ratio of the quantity of water they contain.

2. The power of plants to resist extremes of temperature is directly in proportion to the viscidity of their fluids.

3. The power of plants to resist cold is in the inverse ratio of the rapidity with which their fluids circulate.

4. The liability to freeze of the fluids contained in plants is greater in proportion to the size of their cells.

5. The power of plants to resist extremes of temperature is in a direct proportion to the quantity of confined air which the structure of their organs gives them the means of retaining in their more delicate parts.

6. The power of plants to resist extremes of temperature is in direct proportion to the capability which the roots possess of absorbing sap less exposed to the external influence of the atmosphere and the sun.

Under the subject of wind-breaks an illustration is given of a freeze which occurred in 1909, affecting dissimilarly several orchards in the same locality, being accounted for by the different composition of soils. When we consider how well air circulates through the entire fibrous tissue and how quickly the temperature of even heartwood is thus changed, the roots imbedded in clay responding more slowly to atmospheric influences than exposed parts, light porous soil and warm weather easily account for top growth at any time the winter becomes mild. When even the oak is so injured by a late freeze that new bark is "hide-bound," interfering with growth to the extent of rendering the tree unable to mature a crop of acorns. it is little wonder that frost does so great damage to the soft, coarse fibred fig wood.

In a North Carolina bulletin Massey describes methods for protection from winter weather: "On the coast, in the immediate vicinity of salt water, it will need no winter protection. But in the cold western part of the State the method I have found successful in Maryland will do equally well. This is to branch the trees from the ground, and in fall, after the frost has cut the leaves, bend down the branches to the ground and pin them fast, and then pile the earth over them, mounding it over the center and sloping to the outside so as to throw off the water, or gather the limbs like a cross on the ground and cover each bunch separately with a higher mound in the center, like a four pointed star. They will keep perfectly in cold climates in this way." In milder sections "the best way possible, though very tedious and troublesome, is to thatch each limb and the stem thickly with broom sedge, wrapped on with cotton twine. This is the best protection I have ever tried. But the bending down and covering with pine boughs usually answers very well."

SUNBURN.

It is important to prevent sunburn, as fig borers find ready entrance when bark is removed, greatly hastening decay even to the pith of the branches. Whether this injury occurs in summer or winter it can be prevented by protecting trunks from direct rays of the sun.

It is easy to mistake the causes of sunburn resulting usually from exposure of frosted trees to direct sunlight early in mornings before time has been had for thawing slowly. The rapid shrinking and swelling from alternate frosts and mild temperatures causes the fiber to be injured, and its checked character appears later in the season.

Occasionally it results from hot sunlight during dry weather, not, however, in humid localities, but only in arid climates, the Southern country near the coast being free from this disease. Numerous satisfactory protectors are for sale by nurserymen and plant distributers, but common newspaper tied around exposed bark with woolen yarn is entirely efficient.

FALLING OF FRUIT.

Aside from Smyrna and Calimyrna varieties, which drop their fruit green unless caprificated, the principal causes of losing the crop in this way is excessive dryness, cold weather and lack of tillage. Under exceptional conditions a fig tree can be cultivated until its fruitfulness is impaired; but there is small danger of such unusual care, unless for experimental purposes. Dryness of soil is often the result of insufficient tillage, for by maintaining a good earth mulch on land that has been plowed deep it usually stores ample moisture to provide trees during ordinary drouths, if they are not too close together in rows. Few orchardists seem to realize the demand for plant food and moisture, and how rapidly roots extend, or trees would be given more ground. To maintain a sufficient depth of soil is a task requiring the greatest attention, for trees gradually interlace their roots until the inevitable time comes when all soil is occupied, the task of furnishing fertility increasing as they develop.

WORMS.

Worms in dried figs are hatched from eggs laid after the fruit is cured. This may be avoided by excluding the small moths which deposit them, or dipping the fruit in hot water, or lightly sulphuring in a closed box, or room. Sweet bay leaves scattered through the fruit will prevent infestations.

A number of insects, including vinegar flies, lay eggs in fresh fruit, whenever an opening is found. These soon hatch, for which, of course, there is no remedy other than care in picking.

SOURING OF FRUIT.

The fig sours more readily than any other fruit. Of varieties grown in this country the New French is the best keeper, by reason of its closed eye, fermentation fungus not finding entrance to the delicate juice cells until the skin is broken. Those deficient in sugar sour most readily, and the same variety has a greater tendency to spoil when grown on wet land than where the earth is warm and mellow. A deficiency of fertility promotes loss even to the extent of fermentation forming around the eye several days before the neck is ripe. Smyrna and Calimyrna figs seldom sour, being unusually sweet and grown in arid climates. The Celeste is freer of this objection than others in the Southern States. The Magnolia, or Brunswick, is a fair keeper, being of average sweetness, and it is usually picked just before juice exudes while firm enough to be readily handled. When deficient in sugar acetic bacteria swarm through the eye and quickly set up an acid fermentation, even in green fruit. As an illustration a very remunerative fig orchard rapidly deteriorated in the quality of fruit during years it should have been at the height of productiveness as the soil gradually became deficient in texture and humus, until at length it was impossible to find any that ripened at the neck before the lower half rotted and became offensive; the swarms of vinegar flies indicating the form of fermentation. The Adriatic fig of California is especially liable to sour when grown near the coast, but, like all others, an open eye, or bursted skin, always precedes the entrance of either fungi or bacteria. While extremely wet ground increases the liability of fermentation, that too dry is equally objectionable. The orchard just referred to, as an illustration, was so out of condition as to have no water storage capacity, the earth cracking open a few days after each rain, and fruit was not only deficient in sugar, but so lacking in juice as to be misshapen, and the eyes opened before maturity, as a result of tilling for several years with nothing but a disk, keeping all weeds down, but adding no humus. When trees are furnished a comfortable home for their roots normal quantities of good fruit naturally follow.

A Juicy Fig, suitable for eating while fresh; hence a favorite dooryard variety. It quickly cooks to pieces.

CHAPTER XXIII.

HARVESTING THE CROP.

For home use figs should not be picked until quite ripe, when the flesh has become filled with juice. They are then very palatable, and sweeter than before softening. For canning, or sale in local markets, it is necessary to gather two or three days earlier, as they bring better prices when green enough to retain a natural shape in cooking; but they should be left on the trees as long as possible consistent with the uses intended.

In the South commercial varieties increase in weight about fifteen per cent. daily during the period of ripening, this addition coming from the concentration of natural syrup in the fruit. The amount of sugar required in preserving is also materially reduced when ripened before being gathered.

In the warmest weather figs should be picked every day, and not less than every other day during summer months. In October, when cool nights check growth, several days may intervene between pickings. If ripe, or when the object of the grower is to allow fruit to ripen so far as possible upon the trees, and still remain in condition to be handled, it should be at once placed in shallow trays, or berry boxes, to prevent mutilation. The gathering is

When ripe the fig hangs down, and should be pinched by raising it toward the branch, when the stem will snap in two. Smyrna figs fall when ready to gather.

usually done by boys at a cost of about twelve cents per bushel. An orchard five years of age should yield about three bushels per acre every day during summer. Fruit should not be dumped into bushel measures, but weighed in shallow trays when necessary to estimate the quantity. Picking should be done by carefully raising the fruit up from its pendant position on branches, the stems easily snapping in two; pulling it off causes unnecessary bruising. If a picker works more than an hour or two a day he should wear loose cloth gloves for the "fuzz" on leaves and stems, and upon green fruit, is very irritating to the skin, and as the milky juice continually drops it spreads while at work, causing sensations resembling the bites of a nest of good sized ants.

CHAPTER XXIV.

CURING AND PRESERVING THE FRUIT.

Smyrna and Calimyrna figs are dried in the open air and packed artistically according to the taste of individual distributers. The Adriatic is sometimes dried, but more often preserved and pickled. Such dooryard varieties as Celeste, Mission, Brown Turkey and Ischia are made into marmalades, while the Magnolia is always preserved, its quality and the climates where raised not admitting of sun drying, nor does it compete successfully with Smyrnas when evaporated. As a preserve it probably has no equal in appearance, and its quality is fair.

The Magnolia fig is often cooked skin and all; sometimes it is softened by vigorous boiling a few minutes in plain water, but the skin is usually removed by soaking the fruit in dilute potassium hydrate, boiling hot, afterwards rinsing the caustic solution out by repeated immersions in clear water. It is cooked in pure syrup made from sugar graded higher than granulated, the "Confectioner's A" and "Pebble A" brands, giving best results. This syrup should test by saccharometer from 28 to 32 degrees at the boiling point when the fruit is cooked done. A saccharometer is a syrup gauge used by all confectioners and preservers to measure density, and is the only satisfactory instrument by which uniform syrups can be made throughout a season, sugar rapidly increasing the density of water, which shows at once upon the saccharometer. The fruit is usually cooked from two to three hours. gradually turning darker during the process as the syrup caramels. Deep, barrel-shaped candy kettles are now in common use, their steam jackets covering the bottoms and one-third the sides, giving ample exposure to heat; yet it is believed they will give way to shallow kettles of greater length and breadth, jacketed for steam on the bottom only, and with light wire covers the fruit cannot only be immersed during the entire process, but the time of cooking can be materially shortened, thus improving its appearance.

When reaching the desired color and condition, the fruit is allowed to cool and then filled into cans, or glass jars, sealed up and sterilized. No satisfactory method of filling by machinery has been found, as the fruit is mutilated unless handled carefully. Automatic filling not being practicable, the final packages are filled cold and then sterilized. So soon as the temperature falls below the boiling point spores and bacteria, floating in the atmosphere, enter the preserves, and soon cause ferments and moulds. Most spoilage germs are killed in fifteen minutes at 212 F., but some spores, from which bacteria develop, resist that temperature for three or four hours. The preserver should ascertain for himself how long heat must be applied to render his goods sterile, and should make tests about once a week each season, different and more hardy spores appearing from time to time which require the period to be lengthened or shortened, as conditions change. The higher the temperature the shorter the time, and the longer fruit is sterilized the darker it becomes.

Sterilizing the final packages is done on a small scale by boiling them in some such solution as salt brine, calcium chloride brine, or an oil bath, they having boiling points sufficiently high to raise the temperature of the sealed preserves to a deadly heat. One of the largest plants in the world uses oil baths exclusively for this purpose. In boiling care should be taken to avoid too great a difference in temperature between the bath and the preserves, otherwise steam will generate in the packages and burst them. Preserves which test 31 deg. by saccharometer boil at about 214 degrees F., and it is not safe to use a sterilizing bath more than two degrees higher. When brine is used, the supply of salt, or calcium, should be steadily maintained, as considerable quantities adhere to the cans, or jars, in removing them, reducing the density, while evaporation from ebullition tends to its increase.

Except on a small scale, the most satisfactory method of sterilizing is in a closed chamber where live steam is confined, escaping only under a regulated pressure. In such case the heat generated on the inside of each jar, being no greater, except when cooling, than in the retort on the outside of the packages, there is less danger of the jars bursting. Retorts admit steam at the bottom, having an escape valve at the top of the opposite end. If properly constructed, they withstand fifteen pounds to the square inch, representing a temperature of 250 degrees Fahrenheit. A convenient sized retort will hold fifty cases, or one hundred dozen pound jars of preserves.

The principal danger in sterilizing glass goods is from cracking, which will surely happen to a great many jars if a direct draft of outside air reaches them while hot, for they must cool very slowly. Even tin will burst if the retort is suddenly opened while at a high temperature, for the preserves continue to develop steam inside the cans, while the sudden removal of pressure around them withdraws its resistance to that within, and their sides give way.

The crop from a few acres may easily be preserved with gasoline heat. The first step in such case is to make a frame of half-inch pipes to hold galvanized iron tubs about two feet above the floor. The tubs should be fourteen inches deep, twenty inches wide, and six feet long. A couple of smaller ones for syrup and other special uses will be convenient. For a thousand trees in full bearing six tubs will do very well. Under them place a double row of gasoline burners ten inches apart each way, connected with a ten-gallon reservoir outside the building by a common supply pipe. Place the reservoir in the shade, and have a cut-off valve in the bottom, keeping it well filled, every day, as when entirely burned out the oil in the pipes around the burners is renewed with difficulty. Six tubs will cook twenty bushels at a time without injuring the fruit. Put the figs in the syrup cold, being sure they float, otherwise those on the bottom will burn. If they do not float add more syrup. Heavy preserves do not require any water after the first stew of the season, for the juice from the fruit will not only sufficiently dilute that made from pure sugar, but all cooking should be in open kettles to get rid of vapor. A cover should be made for each tub, however, constructed of one-half inch wire mesh in a strong frame, just small enough to fit inside the top, and by adding a little weight it will press the fruit down into the syrup to avoid stirring, and that floating on top will finish with the rest. A failure to observe this detail will necessitate the removal of about ten per cent. of the fruit for further cooking after the balance is done; or it may result in unnecessarily cooking all to finish that which floats; or the preserver may repeatedly stir the top; or, with steam, he will throw what is underneath to the surface occasionally by vigorous boiling. Any of these expedients will add considerable labor to the one in charge, whose time can be spared the least, and often causes fruit to deteriorate in appearance. The time of cooking can be materially shortened by using shallow vessels, the syrup then being lighter colored and the fruit retaining a plump, rounded shape. It has been said that galvanized iron tubs may be used. This is merely a suggestion from experiments, for, after repeated tests with copper, cast iron, tin, and the most expensive enamel and porcelain ware no reasons are found for preferring one, rather than another, except their durability, weight, convenience, cleanliness and original cost; for the fruit is unchanged in appearance and flavor, there being too little acid to affect any of these metals.

There is a growing trade in fig preserves put up in large tins with light syrup. California ships considerable quantities to distributers in the East, and one plant in the South disposes of its entire output in this way. The distributers repack in fancy glass of their own, selling under individual brands which are gradually becoming established in the trade. As long as sugar can be purchased in Boston and New York cheaper than in New Orleans, and while tins and glassware are made at factories close by, the cost of gallon or two gallon cans in the South is offset by the saving in freight on glass and sugar, and this trade will continue to increase. The Southern preservers will, however, pay freight both ways on sugar, glass and tinware while present high prices prevail, and so long as there is an active demand for the best grade of goods under their own labels; yet advantages are not only in favor of the Northern distributers repacking it, but the simplicity and small cost of preserving in large tins appeal to the average grower, and many will adopt this method of marketing their fruit. The grower is dependent upon local conditions when he sells to neighborhood factories, as well as when he manufactures finished products himself, and his prosperity and independence is probably just as assured by shipping to large distributers to use their own sugar and glass. When the consumers North and East learn to have fig preserves as a daily diet, the present demand will become more active, the jobbers and distributers will go to the orchards and local markets to secure their goods, and by that time growers will have organized and learned to co-operate for marketing crops, their independence and prosperity then being assured.