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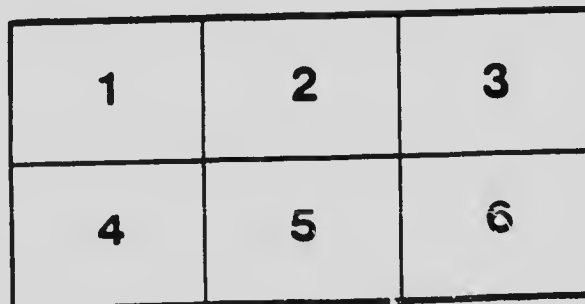
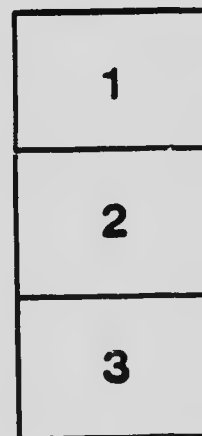
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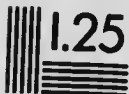
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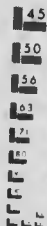
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# HOW TO MAKE AN ORCHARD IN BRITISH COLUMBIA

A HANDBOOK FOR BEGINNERS

BY

J. T. BEALBY, B.A.

AUTHOR OF "FRUIT-RANCHING IN BRITISH COLUMBIA"



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## NOTE

PORTIONS of the matter in this book were originally contributed by me to the *Farmers' Advocate*, but for their use here I have taken the opportunity of materially revising, supplementing, and expanding them.

J. T. B.

March, 1912.

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# HOW TO MAKE AN ORCHARD IN BRITISH COLUMBIA

## CHAPTER I

### CHOOSING THE LAND

ALL present indications point to the apple as likely to be the mainstay and chief source of profit in the orchards of British Columbia. Accordingly, in these pages it is the apple which I have principally in mind.

NEED FOR PERSONAL INSPECTION.—People, perfect strangers, write to me stating that they have bought fruit land in British Columbia, without ever having seen it, and without having any other description of it than the description furnished by the man or the company who is selling to them. How unwise a step this is needs no emphasizing. But what does need emphasizing is that it is especially foolish to buy land without seeing it in British Columbia, because of the mountainous character of the country. Owing to the irregular nature of the surface, the soil is apt to vary a good deal, even within short distances. One acre may be perfectly ideal soil for fruit-growing—red, sandy loam with a clay subsoil at a sufficient depth—while the next adjacent acre, or even



part of an acre, may consist of an accumulation of rock fragments ; or it may be hardpan—that is, indurated and impervious semi-cemented clay—in which no living plant of any kind can exist ; or, again, it may be a bed of dry shingle or arid sand, equally alike useless for fruit-growing. Fruit land in any part of the world should be selected only after a personal inspection, or obtaining disinterested expert advice, and in British Columbia this is especially imperative.

**AIR DRAINAGE.**—It is imperative, not only because of the varying character of the soil at short distances apart, but also because of other reasons arising out of the geographical configuration of the surface. Orchard trees will not thrive unless the air is able to circulate freely amongst them. This is a condition which, in a mountainous country like British Columbia, where the valleys are frequently narrow and often long, is a matter of the very utmost importance. Trees planted in such a position will not grow and thrive anything like so well as trees planted in a more open situation, where the breezes of heaven have free, unhampered access to them. But the chief danger to fruit-trees planted in such “wind-still” localities becomes specially active on the frosty mornings of spring. In such unduly sheltered spots the frost is apt to hang about the trees and cling to the tender, newly opened foliage, or even to the blossoms, until the sun’s rays smite upon it and burn the young leaves or the blossoms irreparably. These “frost pockets,” as they are called, must by all means be avoided. And the best way to avoid them is to select a situation for your orchard in which, owing to the con-

formation of the surrounding country, a free circulation of the air will at all times prevail naturally. Air drainage is as essential to the foliage of fruit-trees as soil drainage is to their roots.

The point I am endeavouring to elucidate may be crystallized in the two following pieces of advice : (1) Don't make an orchard on the bottom of a valley or on a dead flat, and this last applies to a dead flat on a bench or other high ground equally as to a flat in the bottom of a valley. (2) Choose for your orchard land that lies on a gentle slope. The slope must not be too steep. Not that trees will not grow on a steep slope ; for they will, and do. But it is then not so easy to get at them to prune them, spray them, cultivate them, and gather the fruit. The objection to a slope which is too steep is that, when the snows begin to melt in the spring, the water tends to wash or leach off the rich surface soil ; and this danger becomes accentuated after the wild surface vegetation has been removed by clearing and cultivation. Again, if the slope is too steep, you will find it difficult—maybe altogether impracticable—to give that amount of cultivation to your fruit-trees which they require, unless, indeed, your orchard is so small that you are able to do all your cultivation by hand labour. Even a gentle slope, provided the surrounding geographical features are not altogether adverse, will generally of itself secure you an efficient air drainage, and thus give you one of the essential conditions of an ideal orchard site. On the other hand, in Colorado the safest situation for an orchard is often the entrance to the deep cañons, up and down which, day and night, breezes blow with great regularity ; and

the dangerous situations are on the higher bench lands, where the air is more stationary.

**SOIL DRAINAGE.**—In British Columbia, however, no condition of surface is better adapted for a successful orchard in yet another essential respect—namely, soil drainage—than that given by a gentle slope. As the snows melt, which they begin to do, as a rule, soon after the middle of March, the water begins to run down the mountain-sides to the lake or river at their foot. If the slope is steep, it will flow away rapidly. If the slope is gentle, it will in most cases continue to find its way down, at a sufficiently slow rate, during the whole, or at any rate during a great part, of the summer. In this way, through the agency of the natural seepage of the winter snowfall, the roots of the fruit-trees are supplied with liquid nourishment during the whole or the greater part of their period of natural growth, and it is supplied to them, moreover, in the moderate quantities that they need. The supply is at no time in excess, so that water does not stagnate about the roots and waterlog them—a condition of things that is fatal to the successful growth and successful yield of orchard trees.

**ASPECT.**—As regards aspect, some orchardists of experience recommend a slope facing the north-west as being the ideal aspect for an orchard. Now, while it is true that there do exist good reasons for believing that this conclusion is correct, nevertheless it is manifestly impossible for all orchards to have a north-west aspect. A large proportion must of necessity face in other directions. I may say, summarily, so far as my experience and observations go, it does not really matter very much

in what direction your orchard faces. The advantages and disadvantages of each aspect in turn pretty nearly counterbalance one another. A southern slope, while it exposes the early opening blossoms to greater risk of injury by spring frosts, on the other hand puts a higher colour on the finished product. A northern exposure retards the opening of the blossoms, and so minimizes the danger arising from frost; but, to counterbalance this advantage, it does not secure such a high colour in the apple. Provided the orchard is so situated that no ridge or projecting shoulder or bluff of a mountain shuts out too large a proportion of the daily sunshine, any aspect will do. In British Columbia there is generally no lack of sunshine. A north-west slope is on the whole the best, but its balance of advantages does not very greatly exceed those of other aspects. There is only one direction towards which I personally would not be willing to plant an orchard, and that is on land which faces the north unsheltered. On the other hand, if land so situated is sufficiently sheltered and protected against that fierce enemy, the north wind, I would not be deterred from planting even there. Proper shelter can always be secured by planting a suitable wind-break, such as one or more rows of Norway spruce or Lombardy poplar.

Speaking generally, the most favourable districts for growing fruit are those which lie alongside a lake or a big river. The presence of a comparatively large body of water in the vicinity exercises a beneficially moderating influence upon the orchard trees, chiefly by regulating the temperature at the times of dangerous frosts.

**ALTITUDE.**—If your situation is favourable in other respects, you may carry your orchard to very much greater altitudes than is generally supposed. On the northern side of the Rossland Valley, in the south-east of British Columbia—that is, on a good southern slope—orchards thrive quite successfully at altitudes of 3,500 to 3,600 feet; and in the neighbouring State of Montana (U.S.A.) apples grow with perfect satisfaction up to the altitude of 4,500 feet above sea-level. In Colorado apple orchards are eminently successful at much higher altitudes—namely, 6,000 feet and more. As a rule, the altitudes best suited for orchards in British Columbia are those which range between 1,000 feet and 3,500 feet, the lower levels being generally the more suitable.

**COMMUNICATIONS.**—Growing the fruit, however important, is only one part of the business. An equally important, and in the majority of cases a much more difficult, part is that of selling the produce, the finished and ripened fruit. There is one thing which every ranch must possess if this difficulty is to be successfully overcome: it must be within fairly easy and fairly reasonable reach of a railway or a steamboat landing, or there must exist a tolerable certainty that such access will exist before the orchard reaches the bearing stage. It is also very desirable that the ranch should be within touch of a good driving or waggon road. Without it the cost of getting in domestic and other supplies is greatly increased, and the rancher is painfully hampered in his movements, and consequently to all intents and purposes is as though he were almost isolated. Men have made fortunes by settling in a remote valley, and after waiting years have

taken advantage of the enhanced values that follow the advent of a railroad and sold out at a big profit. An instance occurred in 1911 in the valley of the Columbia River, between Golden and Cranbrook, in which the far-seeing and patient pioneer waited nearly twenty years for fortune to come to him. But come it did at last, and well was he rewarded for his pluck and tenacity. But a man who intends to grow—or, at any rate, to sell—fruit cannot afford to do that.

The railway is, however, only a link between the fruit-grower and the market in which he hopes to dispose of his fruit. Consequently he must study further the relative ease of access which, through the railway or lake service, he will obtain to the distant market. (See further chapter on Market.)

EXPERT ADVICE.—On the whole, when the intending fruit-grower is in a position to afford it, it will well repay him to engage the services of an experienced grower, or other person who understands how to grow fruit in British Columbia, and is well acquainted with the climate and all the local conditions, both those which are favourable and those which are unfavourable, either to select land for him or to examine and report upon land which he has selected for himself. This expert advice can be secured at a quite moderate cost.

## CHAPTER II

### SOIL—ROCKS—WATER—TIMBER

SOIL.—In British Columbia pretty nearly all soils alike will grow fruit-trees. The superiority of the fruit of British Columbia is due very largely to a factor which counts for much more than soil—namely, the climate. Not that all soils are of equal value; far from it. Naturally, some are better adapted for producing good fruit than others. The best soil, and the soil which prevails over by far the greater part of the region, is a red or chocolate-coloured sandy loam, generally rather light in texture, fairly well supplied with mineral constituents, but lacking in nitrogen. It is soil that is easily worked, and consequently is inexpensive to manage and keep in proper condition. After a good crop of young red clover, or similar leguminous plant, has been ploughed in, this red loam acquires the proper texture, or degree of associated friability and compactness, that is best suited for orchard trees. (See further, in Chapter VIII., under section on Clover Crops.) The roots are able to work in it with great ease and rapidity, and it promotes the formation of the network of small and delicate fibrous roots and rootlets which have so much to do with the actual production of the fruit.

Another variety of soil which gives excellent results is

of a fine powdery consistency, whitish-grey in colour. This does not cake or run together any more than the red sandy loam does. It has a somewhat silky appearance, and almost a greasy feel. This is known as "volcanic ash." It is of remarkable natural fertility, as also is the red sandy loam, and thus is in every way eminently adapted for growing fruit. This soil is met with, amongst other localities, at the southern end of Okanagan Lake, at Summerland, and elsewhere, and at certain places along the Canadian-United States boundary line.

Still another variety of soil, of probably even greater inherent natural fertility, is known as "black muck." It is heavily impregnated with decayed and rotting vegetable matter, and is found as a rule in the bottoms of the valleys close beside the river or lake which in most cases occupies the greater part of the floor of the valley. But usually this land must be drained before any use can be made of it. As a general rule it admits of ready drainage by the simple expedient of digging a surface trench to the river or lake, or down to some lower lying spot. When drained, this sort of soil is first-rate for growing vegetables, especially for all kinds of root crops.

Gravelly tracts are an abomination, and to be avoided at all costs.

In a few localities really astonishing results are obtained on ground that in some ways is little better than gravel. It consists principally of disintegrated granite or minute particles of rock intermingled with sand and larger stones. This soil contains almost no humus or decayed



vegetable matter, and when dry sets hard, after the manner of cement, and throughout the summer it is pretty nearly always dry. As a veteran fruit-grower observed once when walking across land of this description, "You might turn Niagara across it, and it would still be thirsty." In fact, it wears such a hungry look that a good British or Canadian farmer would consider it not worth a dime or sixpence an acre of any man's money. And yet this soil does, beyond a doubt, produce an abundance of fruit of excellent quality, yielding plums to the value of \$850 per acre, and cherries that bring in over \$1,500 per acre, and even apples that have won prizes in competition with the best fruit of the American Continent. Still, such land is not to be recommended, chiefly because of the great difficulty of getting quite young trees and every kind of intermediate crop to start and take root properly in it.

Do not on any consideration buy hardpan or alkali soils. The former generally lies a short distance below the surface, and is extremely hard, tough, and impervious. No roots can work in it; it holds no nutriment; it prevents the free passage of moisture. Alkali soils or soils impregnated with excess of salts are indicative of a process of desiccation or drying up, or of excessive evaporation, consequent upon faulty irrigation. However induced, they are inimical to plant life generally, and consequently are altogether unsuited for growing fruit.

**ROCKS.**—British Columbia is almost everywhere a predominatingly mountainous country. The mountains consist superficially in great part of bare rock. Consequently it is not surprising to find that their lower slopes are

often littered with fragments of rock, of all sizes and lying in all positions. Intrinsically these rock fragments are not in themselves inimical to good orchards. If you lift up a stone on a mountain-side in even the drier part of the year, you will frequently find that the soil underneath it is moist and damp. Therefore the presence of stones of a fair size scattered over the surface of your orchard slope means so much more moisture for your trees to draw upon in the height of the summer, when the ground on the surface tends to become dry and parched. On the other hand, rocks of the size of boulders, and so also a heavy accumulation of stones, no matter what their size, are a great hindrance to cultivation. They can only be described as a nuisance, and they are a decided eyesore. The best time to remove them is before planting begins. If they are only few in number or very thinly scattered over the surface, they can be left, either permanently or for removal at some later time when work is somewhat slack. The best way to dispose of these is to empty them into some hollow or gully or hole, which it would be an improvement to fill up, or use them for making rubble walls for cellars, barns, or other buildings, or for building fence walls. If they are large they must be cracked with charges of dynamite or by fire, and the fragments removed. When using fire, make the stones red-hot, then pour on them the coldest water you can get. That will generally crack them well. Neither a scattering of loose surface stones nor a few big boulders are so wholly objectionable as a hard gravel-bed. This you can neither dig nor plough, except at almost super-human cost; and even if you do plant it, the trees

will be almost certain to show in divers ways the effects of the dryness which is incidental to such a gravel-patch.

WATER.—Marshy ground, and, in fact, any low-lying spot in which stagnant water stands for any length of time, are alike places to be avoided. To plant an orchard in such situations is to condemn it to failure from the start. On the other hand, water is a prime necessity. In a district in which irrigation is absolutely essential to the production of fruit, as, for instance, in most of the Okanagan Valley, water is, of course, a *sine qua non*. When buying land in such a district, it is every bit as important to make sure that there does exist a good water-supply, and to see that it is adequate for all purposes, as it is to satisfy yourself that the land itself is right. And even in districts where irrigation is not absolutely essential to the production of fruit crops, or is not indeed needed at all, it is a wise thing to make sure that water can readily be obtained if it is needed. This does not mean that there must be a running stream through the middle of the orchard. It is sufficient if there is one not very far distant, or else some kind of a supply stored up for possible use in the height of the summer. In several cases a good well is all that is required. In a non-irrigated country the natural drainage off the mountains, known to fruit-growers as "seepage," is as a rule all that the trees require in the form of sub-soil moisture. But in this respect the conditions vary. In some localities it is found that the quite young trees need more moisture than Nature supplies; in other localities—e.g., in Hood River, Oregon—it is the older

trees, the trees which are bearing heavily, that call out for more moisture than Nature gives them.

TIMBER.—When inspecting fruit land with the idea of buying, it is also prudent to study the timber on it, and, if you can do so, obtain a reliable estimate of what it will cost to clear the land for the plough. It is not so much the number of the trees to the acre as their size and the kind of tree that make the expense of clearing mount up rapidly. It costs proportionally much more to get out a tamarack 2 feet or more in diameter than it does to lift a black poplar or a fir 6 inches through. The former might cost up to 2 dollars, or even more, to remove, whereas the latter could be pulled over by a horse in two minutes at, comparatively speaking, no cost at all.

In many cases the timber can be cut and sold, either for railway ties (*i.e.*, sleepers) or for cordwood (for burning in domestic and other stoves); or if it consists of cedar, it can be used for building barns, stables, or even a log house. In any case, it becomes of value, and to that extent the money which it brings in is so much deducted from the cost of the land. In some districts—*e.g.*, the Arrow Lakes—the local Fruit-Growers' Union collects and sells the timber after the rancher has cut it and hauled it down to the water's edge.

## CHAPTER III

### IMPROVED *v.* UNIMPROVED LAND—PRICES OF LAND— CAPITAL REQUIRED

IMPROVED OR UNIMPROVED LAND.—Almost every man who is thinking about growing fruit in British Columbia finds himself sooner or later face to face with the question, Shall I buy raw land and clear it myself, and after that plant my own trees, or shall I buy an orchard that is already planted, or even an orchard in full bearing? The answer is partly a matter of temperament, partly a matter of capital, and partly a matter of business calculation.

The man who cannot command the requisite amount of capital for a planted, or even for a partly planted, orchard must of necessity content himself with raw land, because raw land, it need not be said, costs considerably less than improved land (*vide* p. 18). But even though a man does possess the necessary amount of capital, it does not therefore follow that he will be wise to buy an orchard that is already in bearing, or a young orchard recently planted. Some people are naturally impatient and eager for tangible results. To such the long wait whilst the trees are growing up is likely to become very irksome and trying. Naturally, they prefer to buy an orchard that is actually in bearing or within measurable distance of bearing. On the other hand, there are quite a number of people who would consider the selec-

tion of the trees, the planting and training of them, and the laying out of the orchard, as tasks of so pleasurable a nature that they would on no account have them done by anybody but themselves. And superadded to this plea of the creative instincts there exist weighty reasons on the commercial side why the man who can afford the necessary capital, as well as the time to wait, should plant his orchard himself, and as a horticulturist grow up along with his trees.

Almost without exception, the older orchards throughout British Columbia contain a great number of varieties. Instances are not unknown where on 10 acres there are twenty varieties of apples alone, to say nothing of other kinds of fruit, or on 20 acres as many as thirty or approaching forty varieties. Now, for a purely local market it is an advantage to have a well-chosen succession of both apples and other fruits. But British Columbia as a fruit-growing region has now passed beyond the stage of a mere producer for local markets. She grows now to supply (as far as she is able to do so) markets on the prairies of the Dominion, markets in Britain, markets in Germany, Sweden, and Holland, markets in Australia and New Zealand, and markets are even calling to her from South Africa, China, and Japan. If this widespread demand, distant as well as eager, is to be properly met, apples must be grown of suitable varieties, of a suitable character, and in suitable quantities to enable the British Columbia grower to export them at a minimum cost. The grower whose orchard is large enough to allow him to export individually will naturally make a close study of the costs of production, and he who

keeps them down to the lowest figure will have an obvious advantage over the man who is remiss or unskilful in this regard. One way by which the costs of production may be kept down by the individual exporter is to grow a few varieties specially suited to the market he is growing for, and to produce each of those varieties in large quantities. By so doing he will simplify the operations of planting, pruning, spraying, cultivating, and orchard management generally, as well as facilitate the processes of picking, packing, and marketing.

And there is also another important reason why the policy just outlined is the one best calculated to secure success in orcharding in British Columbia. The railways and other transportation companies of Canada will all carry a freight carload (minimum 10 tons of 2,000 pounds each) for a considerably lower proportional rate than they will carry 1 ton for over the same distance. Hence a whole carload of any one commodity, all of the same kind, quality, and degree, is not only a more readily saleable unit, but it costs very much less to move about.

For these reasons, and for others arising out of them, the man who is in a position to grow fruit on a fairly large scale will be wiser to make his orchard for himself, plant the varieties he considers it expedient to plant, and aim generally at simplicity and economy of production, and saving of effort in marketing. These ends he is obviously not so likely to secure if he buys an orchard of the older character, with its multiplicity of varieties, and in all probability with numerous other features, all alike inimical to commercial production on a large and economical scale.

True, he may be able to buy an orchard with young trees planted within the last few years that will answer well enough to his conception of a modern commercial orchard, but such are rare. It is the fashion to sell orchard land, planted or not planted, in small lots—10 acres or even 5 acres. There is a vastly greater demand for fruit land in lots of this size than there is for tracts of even 20 acres in area. Consequently, larger orchards of the right description are rare.

Men who possess smaller amounts of capital must naturally content themselves with a smaller orchard. And provided a man understands his business, and is willing to do a fair share of the work himself, he can get a good living off a 10-acre orchard, and even off some 5-acre orchards. And there exist easy means by which he can overcome or remove any disabilities that may attach to the more modest scale of his operations. His remedy is co-operation, working through a local Fruit-Growers'-Association. (See further, Chapter XIII.)

To men who grow fruit on this scale and under these conditions, the older orchards may in some cases be recommended as suitable purchases, or they may be wise to buy improved ranches with growing fruit-trees on them. The local association will be certain to have more or less large quantities of fruit of each or all of one man's special varieties sent in by other ranchers in the locality, so that the association will be able to do what the individual cannot do—namely, make up a carload of this or the other variety or similar varieties.

**PRICES OF FRUIT LAND.**—Prices of fruit lands vary considerably, both the prices of raw lands and the prices



of improved lands. Both kinds are somewhat dearer in the districts which enjoy the widest reputation, such as Vernon and Kelowna in the Okanagan Valley. But price is also to some extent determined by the relative cost of clearing, the amount of improvements effected, proximity to railway and road, and so forth. Speaking generally, the price of raw land ranges from \$50 up to \$250 per acre for small lots, but goes down as low as \$25 or even \$15 for large blocks. Improved land costs from \$200 up to \$350 per acre for small lots, and orchards in bearing sell at \$500 to \$1,000 per acre. In the better-known fruit-growing regions of the United States—Washington and Oregon, that is to say, Yakima, Wenatchee, and Hood River—prices for bearing orchards run up to double the figures I have just quoted.

**TERMS OF PAYMENT.**—Fruit land in small lots is usually paid for in instalments, one-third or one-fourth cash down, and the balance after intervals of six, or twelve, or twenty-four months, 6 per cent. interest being charged on the outstanding instalments. These terms are not, however, invariable; all sorts of arrangements are made, from all cash to 10 per cent. cash, and the time for payment may extend from one year to five or even more, while the interest sometimes is put at 7 per cent., or even 8 per cent.

**CAPITAL REQUIRED.**—Other expenses which will have to be incurred in the majority of cases are the cost of clearing, breaking the ground, planting, buying the trees, fencing, building a stable, poultry-house, and dwelling-house, buying seed and plants, tools and implements, and live stock, also furniture. Each and every one of

these items naturally varies greatly from individual to individual and from ranch to ranch. Land may, of course, be bought for less than \$100 per acre that is quite satisfactory for growing fruit on. Clearing, for instance, may cost anything between \$50 and \$100, or even, as on the Pacific Coast near Vancouver, run up to as high a figure as \$200 and \$250 per acre. Then again, consider the dwelling-house. One man will build himself a house of cedar logs, and all that he will need to find money for will be the doors and windows, and the frames for them, and for the internal linings of the shell, and for the partitions, the cost being, maybe, not more than \$100, or even less. From that figure houses cost all prices up to \$5,000. Probably I shall not be far wrong if I say that the majority of ranchers' houses cost from \$1,000 to \$2,500 each. Other items of a variable nature are the stable, the poultry-houses and run, the family living, the seeds and plants, the furniture, and the fences. The following table is consequently offered merely as a model, and is not to be taken as in any sense a final, or even a complete, statement of the expenses connected with the starting of a fruit ranch in British Columbia:

	Dollars.		Dollars.
Land, 1 acres at \$100 ...	1,000	Family living (2 years) ...	1,200
Clearing and ploughing at \$100 ...	1,000	Live stock (horse, cow, pig, poultry) ...	275
Fences ...	100		6,050
Dwelling-house ...	1,250	<i>Contra:</i>	
Poultry-house ...	50	Potatoes, second year	750
Stable ...	400	Strawberries ...	50
Furniture ...	200	Eggs (2 years) ...	100
Fruit-trees ...	250	Milk and butter sold	100
Seeds and Plants ...	250		1,000
Tools and Implements ...	75		5,050

If the rancher does all the work himself, or if he is a bachelor without a family, he may reduce the above expenses by about \$1,300, thus bringing the prime cost down to about \$3,750. So that, on the whole, putting the price of land and the cost of clearing it together, as I have done above, at \$200 per acre, I should consider that a man buying 10 acres would require a capital of £700 to £1,200 all told, if he is to carry along comfortably and safely until his orchard begins to bear consistently in the sixth year. This estimate makes all due allowance for crops grown between the trees during the second, third, fourth, and fifth years, but allows nothing for timber sold off the land, nothing for produce of the soil the first year, nothing for money earned in the owner's spare time. On the other hand, it does include cost of living for a small family for the first two years, the Government tax for the first five years, proceeds from poultry during every year of the five, and, of course, all the various items enumerated just above.

**TAXATION.**—As a fruit-rancher, the orchard-owner pays only one tax and no rates whatever. The tax is a levy of  $\frac{1}{2}$  per cent. upon the assessed value (say 80 per cent. of the actual market value) of his real property, with a 10 per cent. discount for prompt payment.

**IRRIGATION CHARGES.**—To the items of expenditure just enumerated must be added the tax for irrigation water if the ranch is selected in an irrigation district. This will amount to \$2.50 to \$5 per acre, or \$25 to \$50 per annum ; so that in the course of the five years the

expense on this account would amount to \$125 or \$250. In a non-irrigated district this expense would not generally be incurred, although, on the other hand, it might even there be necessary to dig a well or put in a small wooden flume, or even an iron pipe, at a cost of anything between \$10 and \$200.

## CHAPTER IV

### CLEARING

IN many of the older orchards of British Columbia you will observe the short, blackened stumps of former forest trees remaining scattered amongst the live apple and other fruit-trees. These evidences of incomplete clearing are veritable eyesores to the man who loves his orchard. Nay, they are worse than eyesores; they are serious hindrances in the way of cultivation. Big rocks prevent you from ploughing straight along, but in recompense they do hold a small amount of moisture; but big tree-stumps not only block the path, they fail to give any sort of compensation whatever. On every account it is decidedly preferable to clear everything off the land in the first instance that you would not wish to retain there perpetually. A clean sweep costs very little more than a partly finished job, and it makes all your subsequent operations so very much easier, so very much more satisfactory, and proportionally much cheaper.

The methods of clearing are many. Some people use machinery—*i.e.*, stump-pullers. Others rely upon chains and pulleys, using horses for their motive power. Others make dynamite and stumping-powder do the work. Others, again, employ fire; and yet others put their trust for the most part in the muscles God has given them in their own arms.

**SLASHING AND PILING.**—Before any of these various methods are put into force, it is usual to cut down all the scrub or smaller bushes, young trees and saplings, and all kinds of undergrowth, and pile it up for burning, as well as saw through the bigger forest trees. Some people burn these last along with all the rest, but that is wasteful and extravagant. If there are a sufficient number of these logs of suitable size, it is better to cut them up for railway sleepers, known in Canada as "ties," or into cordwood for domestic use. Or they may be drawn to one side and stacked up for future use at home, or for making into fence posts and rails, or for constructing pigsties and other outhouses.

**BURNING.**—When the scrub has been slashed and piled—and there are one right way and several wrong ways of piling it—it is burnt. In the process of burning the scrub the stumps of many of the bigger trees that have been cut down will become charred. In several of the irrigated districts there is an absence of scrub, and the big trees are fewer in number. To that extent the initial costs are consequently reduced. Owing to the many and seriously destructive forest fires which ranged throughout the province of British Columbia in 1910 and previous years, the Government in 1911 took extra precautions to prevent this danger and minimize the great loss that resulted by greatly increasing the number of fire wardens throughout the province. A further consequence of this and of the other precautionary measures adopted was that no bush fire or clearing fire was allowed to be lighted between the beginning of May and the end of September. This proved in many cases a decided hardship to new

settlers, anxious to make progress with the preparations for their orchards.

**STUMP-PULLERS.**—If the orchard-maker is able to command the necessary amount of capital for purchasing the plant, the most efficacious and in the long run the most economical method of clearing is to employ machinery—namely, stump-pullers driven by a donkey engine, or worked by horses or oxen. While the plant varies, of course, a good deal in price, it may suffice for general purposes to say that a satisfactory equipment can be bought for \$200 to \$350. What the subsequent cost will be—namely, the cost of the actual operations of clearing—is obviously a very variable figure. It depends partly upon the size and character of the trees, partly upon their number and partly upon the description of the surface. So far there are very few data available as to actual cost of clearing by machinery. In one case that has come to my knowledge the cost of the actual operations amounted to \$50 per acre; in another place to \$65. Near Vancouver, where the timber is not only large, but dense, clearing by machinery has cost, if I remember correctly, over \$200 per acre.

**CHAIN AND PULLEY TACKLE.**—Next to machinery comes the chain and pulley tackle. The apparatus consists of stout steel logging chains and two or more steel pulleys, and a team of horses. One end of one chain is fastened round the stump to be removed, one end of the second chain round some big stump conveniently near to serve as an anchorage, and the two are then connected together by a pulley at which the horses pull in such a way that the force brought to bear directly upon the

stump you desire to pull out is equivalent to from two to five teams all straining together.

By both those methods just described—that of stump-pullers and the three-pulley tackle—the roots are apt to come out in one big mass, weighing sometimes a ton or more. This makes it necessary to remove the soil from the roots, a process which often costs a considerable amount of labour, and in British Columbia labour is expensive. This drawback does not accompany any of the methods I now proceed to outline.

**BLASTING.**—The method of stumping most in favour with ranchers and the men who usually clear for them is to bore a hole well down under the centre of the stump, using an augur or an iron bar. Then place in it from one-quarter up to as many as a dozen, or even more, sticks of dynamite or stumping-powder, or both combined. Ignite a fuse, and then retire to a safe distance. After the explosion they gather up the pieces and fling them on the pile to burn. This is a costly method, especially if the explosives used are not paid for by the men who are using them. There is also a certain amount of danger associated with it, owing to the naturally unstable character of the explosives. Hence, for the new settler, until he becomes familiar with the character and peculiarities of dynamite and stumping-powder, it is wise to contract with those who do understand them, and leave the latter to provide their own dynamite and powder.

**AUSTRALIAN JACK.**—I once had for a few weeks the loan of an extremely useful implement—namely, a patent jack, made in Victoria, Australia, which could be levered



up some half an inch at a time, notch by notch, and in the hands of a single handy man was capable of lifting a dead weight of 12 tons. This instrument was employed in the following manner. The stump was first split open, not blown completely out of the ground, by a small charge of stumping-powder. Each of the pieces into which it split was then attacked in turn and levered out of the ground with the jack, and finally drawn away by a single horse. In this way a very considerable economy was effected in the use of explosives. The instrument would be of peculiar and valuable service for clearing amongst fruit-trees or close to buildings, where heavy charges of powder or dynamite could not be used without risk of doing serious damage to trees or buildings.

**STUMP BURNING.**—For burning the stumps as they stand two or three different methods are recommended.

In the charpitting method a ring of kindling is piled round the base of the stump, on the surface of the ground, and the kindling covered with sod to the depth of 6 inches, except at one point, preferably a point on the windward side. It is at this point that the fire is started; but when the kindling gets well alight and is burning strongly, this opening is also closed up. The fire is then left until the whole of the stump is charred through and through. This method is, however, only suited for soils in which there is a fairly large percentage of clay. In sandy soils it is not so efficacious, for as the stump's fangs char away, the loose earth tends to fall in, and so put the fire out. To overcome this difficulty, a trench must be dug several inches deep, and the bark removed from the stump and from its fangs as deep as the trench goes.

But then, again, the sod from sandy soil tends to crumble to pieces, letting the sand trickle in amongst the fire. Charpitting would seem, therefore, to be a method better suited for heavy soils.

Another method of burning the stumps *in situ* is to bore holes under the stump (this can be done by the same engine), insert iron pipes turned up at the end to act as blowpipes, and force draught or air down them from a fan or blower driven by a gasolene engine. By employing this method—which, however, is hardly likely to commend itself to the small orchardist or the inexperienced settler—stumps from  $2\frac{1}{2}$  to 5 feet in diameter are burned out at a cost of \$1.60 to \$3 each, say an average cost of \$2.30 (= 10s. each).

LEVELLING AND BREAKING.—Having cleared all impediments off the land, your next procedure will be to level it to some extent by drawing over it a harrow or some sort of home-made scraper. In many cases this will be sufficient. There are cases in which a large road shovel would be useful, but generally an implement of that kind is not readily obtainable, and the rancher has to proceed without it.

Levelling is followed by ploughing or breaking the land. On the light loam, so characteristic of British Columbia, if the ground has been well harrowed first both ways, with such an implement as a spring-toothed harrow the task of breaking is not so very difficult or formidable.

Having got our land broken, and once again levelled by harrowing, we are in a position to begin the work of actually making our orchard.

The soil of British Columbia is, as a general rule, lacking

in nitrogen. The best time to make good the deficiency is at this stage, before any tree-planting is done, and the best means of supplying the nitrogen is to sow clover, preferably red clover. Through the bacteriological activity set up in and by means of the roots of the clover, nitrogen is abstracted from the atmosphere and communicated to the soil in a form in which it can be readily assimilated by the young fruit-trees. Theoretically this is beyond all question the best plan to follow—namely, to sow red clover in the late summer or early fall, and plough it in the following spring or early summer. After that plant your young fruit-trees. In actual practice, however, the course of procedure is in the vast majority of cases different. On the small holdings which nearly all the fruit districts in British Columbia alike favour men plant as they clear, an acre or two at a time. It is in most cases a matter of vital necessity to obtain a revenue as early as possible from the young orchard, and to that end time is of the utmost importance. Accordingly, most men plant their trees first and then sow the clover.

Instead of red clover, some practical men of considerable experience recommend that alfalfa or hairy vetches be grown. But these crops, too, must be ploughed in as soon as may be, even though a second sowing may have to be made.

SOME RESULTS.—The cheapest clearing that has been brought to my knowledge was done for \$15 per acre, but, unfortunately, I do not know exactly what it consisted of. In some parts of the Okanagan, where the timber is very light, clearing has been done at \$25 to \$50 per acre.

In East Kootenay \$35 to \$60 per acre are the figures at which a good deal of clearing has been and is being done. Near Castlegar, at the confluence of the Kootenay and Columbia Rivers in West Kootenay, land has been cleared with a stump-puller for a cost of \$20 to \$25 per acre, powder being used to split the bigger stumps—that is to say, those which exceeded 20 inches in diameter. Along with the stump-puller draught oxen were used instead of horses. Two oxen turned the windlass of the stump-puller, and a third drew back the heavy cable from off the drum and dragged it to the next stump. In this case the stump-puller cost \$325. In other parts of West Kootenay the cost of clearing runs up to \$50, \$90, and \$100 per acre, and occasionally more.

## CHAPTER V

### INTERMEDIATE CROPS

DURING the first two or three years the fruit-rancher is much more keenly interested in the crops that he grows between the young orchard trees than he is in the trees themselves. These crops consist chiefly of roots, forage, crops, and small fruits.

ROOT CROPS.—Of root crops, the most important by far is potatoes. They are comparatively easy to grow, they yield well in the light sandy soils of British Columbia, and they sell for good prices. In the autumn or fall potatoes dug straight out of the ground fetch in car-load lots \$20 to \$30 per ton. In the spring, after the winter breaks up, they are wont to be scarce and dear. Prices range then between \$40 and \$50 per ton, and I have known them to jump up for a short space to even double the latter figure.

Potatoes are a very serviceable crop to grow as the first crop after breaking the land. They insure its being well worked, and that is beneficial in that it sweetens the soil and corrects its acidity and sourness. Where the ground was occupied by fir, pine, or other coniferous trees, the soil is wont to be more or less impregnated with turpentine. The effects of this must first be got rid of before one can hope to grow the majority of crops with

anything like success. A crop of potatoes will do fairly effectually. Ashcroft, near the point where the Fraser River changes its direction from west to south-west, has gained a high reputation for potatoes. In the beginning of November, 1911, the province of British Columbia carried off at New York, at the Pan-American Exhibition, against an array of sixty competitors drawn from all parts of the American Continent, the Stilwell Trophy and \$1,000 for the best collection of potatoes, 102 varieties being staged in the exhibit.

Other root crops which it pays to grow between the trees are turnips and mangolds, more especially if the rancher keeps a cow or pigs. There is a limited market for both crops, as also for carrots, for giving to dairy cows and feeding horses at the logging camps and mines, and in the towns.

Onions are profitable, but they require stronger, stiffer soil than is generally found in British Columbia. Nevertheless, one grower at Kelowna has been highly successful with this crop, and is reputed to have made quite a fortune from the business.

CLOVER, ETC.—If the fruit-trees only are considered, a far better crop to grow is red clover, lucerne (known in Canada as alfalfa), cow-peas, hairy vetches, or some similar leguminous (*i.e.*, pod-bearing) plant. All these serve to put nitrogen into the soil, and nitrogen is the one property which as a rule the British Columbia soils are deficient in. They also supply humus, or decayed vegetable matter, an ingredient of the utmost possible value, as it holds and stores up moisture against the dry, hot months of the summer. Properly speaking, these

leguminous crops ought to be ploughed in ; but for one year, at any rate, or possibly for two, the rancher who is straitened for capital may mow the crop and sell the hay, though he must understand that by so doing he is robbing his young trees. Hay always fetches good prices, generally in the neighbourhood of \$15 to \$20 per ton. Clover and alfalfa are best sown on the top of the snow just before it finally disappears in the latter part of March or the beginning of April. Twenty pounds to the acre is the quantity usually sown ; of hairy vetches, 50 pounds to the acre.

On no account should cereals, such as wheat, oats, or barley, be grown amongst fruit-trees. They rob the trees of moisture, and the trees want always all the moisture they can get. But there is no objection even to cereals if they are turned in green, or cut green and used as fodder.

The value of clover as an orchard crop will be still further discussed at a later stage. (See section on Cover Crops, Chapter VIII.)

VEGETABLES.—Unless the ranch is situated close to a market—that is, a town, logging camp, saw-mill, or mine—it is not profitable to grow vegetables, except in large quantities for “shipment” away in carload lots. And even close to the towns the rancher has very formidable competitors in the Chinese “truck,” or market-gardeners, who are adepts at growing such produce as celery, onions, lettuce, marrows, cucumbers, cabbage, peas, rhubarb, and various kinds of salads. They even pay rents as high as \$50 up to \$125 per acre for ground for market-garden purposes. With them labour is cheap, and they make high prices of their produce.

Celery is grown on a large scale at Armstrong, at the north end of the Okanagan Valley, the average yield being about 8 tons per acre, which sells for \$400 to \$600.

**SMALL FRUITS.**—Under this heading are understood strawberries, raspberries, blackberries, gooseberries; red, black, and white currants. Of these, strawberries are the most useful. The plants, once planted, are commercially good for four years. The rows should be wide enough apart to allow of an ordinary horse cultivator to be drawn up and down between them—say,  $2\frac{1}{2}$  to 3 feet. The plants in the rows may be any distance from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  feet. An acre of ground requires from 5,000 to 7,600 strawberry plants to cover it. In British Columbia it is advisable not to plant a larger area with strawberries than the grower can see a pretty fair prospect of getting gathered every day. Young strawberry plants can generally be bought for \$8 to \$10 per thousand, sometimes for less. This crop can be grown profitably for \$2 per crate of 24 pounds, but not for a smaller price. If the crate will not fetch \$2, it is better to send the fruit to a jam factory. The price usually made ranges from \$2.50 to \$3.50 per crate. An acre of strawberries should produce from \$250 to \$500, as grown on the majority of ranches. Mr. O. J. Wigen, near Creston, has made nearly \$1,000 per acre of strawberries. The best varieties to grow—solely because they travel well—are Magoon and Clark's Seedling, the former being probably the heavier bearer.

Raspberries bring in from \$500 to \$900 per acre. They must be planted by themselves, as the canes continue to send up suckers all round them, and these are apt to inter-



ferre with the roots of the fruit-trees if they spring up too close to them. Young raspberry canes can usually be bought for \$2 per hundred. The fruit is in great demand for making into jam by the jam factories. The prevalent variety is the Cutlibert, but a new variety, the Herbert, is reported to be an improvement on it. Plant in rows 6 feet apart, placing the plants  $1\frac{1}{2}$  to 2 feet distant in the row.

There is a keen demand, too, for blackberries for the same purpose. The price runs higher than the price of raspberries. Whereas the latter generally sell for \$2.50 to \$3 per crate of 24 pounds, blackberries fetch, as a rule, \$3.50 to \$4 per crate. The Erie, Snyder, and Evergreen are all good commercial varieties.

For black currants, again, there is a strong market, at about the same prices as are paid for blackberries.

Red currants are not in very great demand, and for gooseberries and white currants the demand is comparatively small. The prices for these three varieties last mentioned are \$2 to \$3 per crate.

If the rancher happens to be within easy reach of a jam factory, he will find it quite profitable to grow small fruits to sell to it. These factories give good prices, and the gathering of the fruit for them is greatly simplified.

**POULTRY.**—Although it cannot literally be described as a crop, the keeping of poultry is a branch of ranch economy which no good rancher should neglect or overlook. It pays best to keep pure-bred birds. Such make higher prices for breeding; they grow quicker and thrive better. Eggs fetch 35 cents to 75 cents per dozen.

Young chicks do not die on the dry sandy soils of British Columbia to the same extent that they do in England. But they have more enemies of the predatory type to face—namely, skunks, coyotes, weasels, hawks, and others, the first-named being the most destructive. Live chicken sell from 10 cents to 11 cents per pound, so that a good plump bird will fetch from 80 cents to \$1.

## CHAPTER VI

### VARIETIES TO PLANT

APPLES.—At the present day there are far too many varieties of apples being grown in British Columbia. If you take up the schedule of prizes offered at any of the local fruit fairs in the province, you will find that the number of varieties of apples alone amounts to thirty, or even more, and there are a very large number of varieties for which no prizes are offered at all. Now, partly because of her wide geographical area, partly because of her comparative absence of large centres of population, and partly because of the fewness as yet of the population which she does possess, British Columbia must of necessity be an exporting country. If she is to be compelled to find markets for her fruit at a distance from her own borders, it is obviously the true commercial policy to grow the fruit and the varieties which will travel best, and go farthest without injury. Manifestly, then, the apple is the fruit that must be grown. But for a sound and successful commercial export trade thirty to forty varieties of apples are distinctly too many to grow. It is altogether too much to expect the consumers of apples in so many parts of the world to make themselves sufficiently familiar with that number of different kinds of apples so as to appreciate properly their several merits and good qualities.

Out of the long list of varieties grown, experience is gradually selecting the fittest. By the fittest I mean not only those that it is most satisfactory to the rancher to grow, but those that it is most satisfactory to the buyer to purchase. Time will, no doubt, still further reduce the list, which embraces about one dozen varieties, and is as follows : Wealthy, Wagener, Jonathan, Spitzenberg, McIntosh Red, Northern Spy, Cox's Orange Pippin, Rome Beauty, Winesap, Gravenstein, King of Tompkins Co., and Yellow Newtown. To these may be added in the second degree : Grimes's Golden, Baldwin, Fameuse or Snow, Red Cheek Pippin, Winter Banana, Golden Russet, Ontario, and Ribston Pippin.

In these lists no early or summer varieties, such as Duchess of Oldenburg, are included, because they will neither keep nor travel well. The variety amongst the above which ripens earliest is Wealthy, in the beginning to the middle of September. This variety is in demand in Australia. Wealthy is followed by Gravenstein ; then comes McIntosh Red, then Jonathan, Cox's Orange, King, and Spitzenberg ; and then the late winter varieties, ripening pretty much together. The English market will buy Cox's Orange, Yellow Newtown, Spitzenberg, Jonathan, Northern Spy, Grimes's Golden, Golden Russet, Baldwin, King, and Ribston. The Northern Spy is the best seller on the prairies. Jonathan, McIntosh Red, and Spitzenberg fetch high prices in the United States ; Wealthy, Gravenstein, Wagener, and McIntosh stand high in the local markets. In point of intrinsic quality the best amongst the above are Cox's Orange, Spitzenberg, Gravenstein, Jonathan, Northern Spy, McIntosh Red,

Wagener, Grimes's Golden, Fameuse, Winter Banana, and Wealthy. Good sellers, though apples of poorer quality, are Rome Beauty, King, Baldwin, and Red Cheek Pippin. Golden Russet and Ribston are favourites in England. So far as my own experience goes, I would recommend the rancher to make his selection from the following varieties. If he plants 10 acres, he should confine himself to three, or at the very most four. The curtailed list is: Wagener, Jonathan, McIntosh Red, Northern Spy, Cox's Orange, Gravenstein, King, Rome Beauty, Spitzenberg, and Wealthy. Wagener and Jonathan both come into bearing comparatively early, Northern Spy comparatively late. All of these varieties succeed well in the interior of the province; King and Duchess of Oldenburg do best in the coast districts. For altitudes above 2,000 feet those varieties which require a long season for ripening their fruit, such as Northern Spy and Yellow Newtown, should not be planted. Spitzenberg and Winesap deteriorate in quality at high altitudes. In such situations the varieties which succeed best are Duchess of Oldenburg, Wealthy, McIntosh Red, Gravenstein, Jonathan, Wagener, Rome Beauty, and Grimes's Golden.

But the choice of the man who plants only 10 acres will be, or ought to be, pretty well determined for him by what his nearest neighbours have already planted. For commercial export he will find it so advantageous to combine with his neighbours that he cannot well afford to grow different varieties from what they grow.

Of course, every rancher plants a tree or two of different varieties for domestic use, and here he can follow his own fancy absolutely unfettered. And this applies

to other kinds of fruit as well—pears, plums, cherries, peaches, apricots, and so forth.

**OTHER FRUITS.**—If the rancher prefers to grow pears for export, the Bartlett (Williams's Bon Chrétien) is by far the best seller; but it must be gathered green, and will not keep long after it gets ripe. Other good commercial varieties are Flemish Beauty, Howell, Doyenné du Comice, Beurré Clairgeau, Beurré Anjou, and Duchesse d'Angoulême.

In plums the most valuable from every point of view is the Italian Prune. Amongst other varieties, it must suffice to mention Bradshaw, Burbank's Sugar Plum, Lombard, Colombia, Yellow Egg, Washington, Peach, and Greengage.

The most desirable of the sweet cherries to grow are Bing, Lambert, and Royal Anne. All three sell well. The last-named brings in the highest price per pound. Early Richmond, Olivet, and Morello stand first amongst the sour or preserving cherries. Windsor is an excellent sweet cherry. May Duke is valuable.

Peaches are grown commercially in the Okanagan Valley, but the growers are being gradually—in some cases rapidly—converted to the opinion that they would do better to grow apples. If peaches are planted, I would strongly advise the planter to stick to the earlier ripening varieties, such as Alexander, Yellow St. John, Triumph, Early Hative, and Early Crawford.

Grapes, apricots, and quinces are not likely to be extensively grown on the commercial scale in British Columbia.

## CHAPTER VII

### PLANTING—METHODS AND PROCESSES

IN planning an orchard the object should be to cover the whole of the ground as far as possible with trees, so that no part of it is left unoccupied. There are two principal systems by which this aim can be most economically accomplished. One is known as the square plan, the other as the hexagonal plan.

**SQUARE PLAN.**—In this arrangement the trees are planted in straight lines up and down the orchard, as well as across and across. The rows are best drawn 30 feet apart, and the trees planted 30 feet apart in the rows. This defines the positions of the permanent trees of the orchard. But along with the permanent trees it is customary to plant what are known as "fillers." These are trees which it is intended to cut out after a few years, when the permanent trees have grown so much that they need more room. The fillers are planted half-way between the permanent trees in both directions, across and across and up and down; or—another arrangement—in each square formed by any four of the permanent trees the filler is placed in the middle, at the intersection of the lines joining the opposite corners diagonally. The former arrangement requires a total of 133 trees (49 permanent trees and 84 fillers), the latter 85 trees (49 permanent

trees and 36 fillers.) The former total is too large ; the latter is the one to be recommended. The fillers are generally some variety of apple that comes into bearing at an earlier age than the permanent orchard trees. The varieties usually chosen for this purpose are Wagener, Wealthy, Winesap, and Missouri Pippin, or some variety of crab apple (which are in demand for making into apple jelly and for canning). In British Columbia it is one of the first two that is generally selected, Wagener or Wealthy.

**HEXAGONAL PLAN.**—This is the arrangement which allows the greatest number of permanent orchard trees to be planted to the acre—namely, 56. The fillers are placed alternately with the permanent trees in each row ; this gives 56 trees. Sometimes a row consisting entirely of fillers is put in between every two rows of the permanent trees, which calls for 42 more fillers. This makes a total of 56 permanent trees and 98 fillers to each acre, or 154 trees altogether. This is too large a number, and it would be better to omit the alternate rows of fillers. Even then the acre would accommodate 112 trees.

Instead of one of the varieties of apples mentioned above, peaches or dwarf pears are preferred by some for fillers. In each case the relative distances remain the same.

By planting a permanent tree at one end of the first row, and putting a filler opposite to it as the first tree in the second row, you will find that your orchard, when finally thinned out, has its trees arranged hexagonally or in diamond fashion.

**TREES FOR PLANTING.**—If a tree is improperly planted,



it will in all probability show the ill-effects during the whole of its existence. Hence it is a matter of the utmost importance that the planting should be properly done.

Plant no trees except one-year-old trees, though you may have them grafted or budded on two-year-old roots. And it is wise to buy your trees, provided they are satisfactory, from the nearest local nursery. Not only are such trees better acclimatized, but they have a shorter journey to make, and hence run less risk of suffering damage or injury, besides which they travel for less cost. As soon as ever you receive your trees heel them in at once in the middle of the orchard they are to be planted in. On no account must the roots be exposed to the risk of drying out, a danger they are especially liable to in the parching atmosphere of the interior of British Columbia.

In order to make sure that you shall have your rows straight, it is well to peg out beforehand the places in the first row which the trees are to occupy. Then, if you keep your distances true, your trees will all come into their proper places in the other rows, and all your rows will be symmetrical and mathematically exact.

To insure the better fertilization or pollenization of the blossoms, it is advisable not to plant a solid mass of any one variety, but to plant two to four rows of each variety in succession.

PROCESS OF PLANTING.—Take a piece of flat board 6 feet long and 4 inches wide. Cut a small notch in each end, and a bigger notch half-way along one side. Fit this bigger notch around the peg that marks where the tree is to go. Put a smaller peg in each of the smaller notches at the ends of the board. Take the board away, also the peg for the tree, leaving the two smaller pegs.

At the point where the peg for the tree stood, dig a hole 2 feet across, putting the top spit of soil on one side by itself, and break up the earth in the bottom of the hole. Then, and not until then, take your tree out of the ground where it has been heeled in. Hold it up in your left hand, and with a pair of secateurs, or pruning shears, prune the roots, cutting away all broken or injured fibres, and shortening back those which are excessively long. Cut at a slant, and in such a direction that, when the tree stands upright in the hole, the cut surfaces will all lie flat on the earth. Place the tree in the hole, spread out the roots well all round, and see that none are doubled up or lying across the others—both these points are important—and gently shake in some of the top spit after breaking it up fine. Work this well in amongst the roots. Cover the roots to the depth of 3 inches or so. Joggle the tree gently up and down, and then tread the soil firmly round it, taking care not to break or injure any of the roots. Fill up the hole with soil, and tread firmly again. When you have finished, the little tree should be about 4 inches deeper in the ground than it was when it stood in the nursery row. This is to allow of the soil settling. Finally, if you are planting in the spring, cut off the top of the young tree at a distance of 18 inches to 2 feet from the ground level, cutting in a slanting direction up to a good fat bud, so as to leave the bud at the highest tip of the young tree. If you are planting in the autumn or fall, leave this cutting until the following spring.

Do not give the young tree any manure of any kind unless you are planting in ground which has not been properly broken and properly prepared. In the latter case sprinkle a little—say a tablespoonful, not more—of

nitrate of soda around the tree, keeping it away from the bark. On no account put any water in the hole with the young tree ; though, if the ground is excessively dry, you may pour one or two bucketfuls of water over the roots when you have finished the planting.

All through the operations be particularly careful you do not let the roots of the young trees dry out. A few minutes' exposure will suffice to spoil them. It is a good plan to have all the holes dug first, or, at any rate, a large number at a time. And even then, as you lay the trees down whilst you are actually engaged in planting one, keep the others covered with a damp bag or sack.

FALL v. SPRING PLANTING.—One sometimes hears discussions as to the respective advantages of fall and spring planting. As an academic question, there can hardly exist a doubt that it is preferable to plant in the fall. This gives the young tree a chance to make an early start in the following spring before the hot days of summer arrive. The fall is the season, too, when the majority of fruit-growers have the most time to spare, and the planting can consequently be done more leisurely, and, what is of the first importance, more thoroughly. The principal objection to fall planting is that the young fruit-trees do not become sufficiently dormant to lift in the nursery until the season is too late ; and to plant young trees which are not dormant is folly. These remarks tell with double force if the trees are being purchased from a nursery situated in a warmer or milder locality than that in which the orchard is to be made. Hence the practice almost universally followed is to plant in spring, and as early as possible in the spring.

## CHAPTER VIII

### CULTIVATION AND MANAGEMENT

IN the interior of British Columbia the climate is dry. As a rule very little rain falls during the summer. The orchards depend to a very great extent for their moisture upon the snowfall of winter. As the snow melts—and it goes on melting on the mountains right into July—the water trickles down the mountain-side, giving rise to the “seepage” nourishment of the orchard.

**MOISTURE CONSERVATION.**—One of the principal aims of the orchard-owner, as, indeed, of every agriculturist and farmer in Western and Middle America, is to take such measures and carry out such operations as shall to the fullest extent preserve this moisture, and prevent it from going to waste through evaporation. One way to secure this end is to keep the surface during the growing season constantly in a fine, powdery state, as fine as finest dust. If this surface soil gets dry, it will be all the better; it will keep the soil underneath moist. The roots always work into the moist soil, and if the soil is dry on the top and moist underneath, the roots will go down and not come up. If they come up, they will be liable to get scorched by the hot sun.

Begin to cultivate, using a Kimball cultivator or a fine-toothed light harrow, as soon as the ground is dry enough

to bear the horse in the spring ; that is, a few days after the snow has disappeared. Do not wait until the surface begins to get really dry. Your object is to preserve every drop of moisture that is already present in the ground. Continue to cultivate at intervals of a week or ten days, and cultivate always after every shower of rain, until the middle of August. Then stop ; do not cultivate any more. Rains generally come in September, and if you continue to cultivate after the middle of August, you will keep the trees growing, and have soft wood—that is, twigs—for the winter. By stopping cultivation in the middle of August you arrest growth, or nearly so, and give the young wood an opportunity to become thoroughly ripened ; and it is in that condition that it will best stand the sharp frosts of winter. If the trees grow too vigorously and make too much wood, grow a crop of clover or other cover crop between them.

**MULCHING.**—Sometimes, when it is inexpedient or difficult to cultivate so often as once a week or once every ten days, it will help to conserve the moisture if you spread a mulch of cut green clover or other forage crop round the bottom of the young trees. If you should for any reason leave a mulch round your trees all the winter, be careful to draw the material 4 or 5 inches back from the stem of the tree. Rabbits and mice often take shelter in such mulch material during the very coldest weather, and it is then a temptation to them to gnaw the bark of the young tree. The tree will not suffer by having the earth exposed just around its base.

If you plough early in the spring, as you probably will for the benefit of the crops which are to be grown between

the trees, do not plough deep in places where your ploughshare would be likely to encounter the roots of your trees. Four inches is quite deep enough close to the rows, though farther away you may, of course, plough deeper.

You may continue to grow crops in between the trees until such time as the roots of adjacent trees and the spread of their branches nearly meet. As a broad rule, it may be taken that the roots reach as far away from the trunk of the tree as its branches spread.

MANURING.—An orchard in good trim, with the trees healthy and vigorous, and bearing well, but not too heavily, should be manured every second year, either by applying farmyard manure or by ploughing in a cover crop of green manure and letting it rot in the ground. Orchard trees need principally three manurial elements : nitrogen, which promotes the vegetable growth of wood and foliage ; potash, which supplies nutriment to the fruit, giving it quality, colour, and flavour ; and phosphoric acid, which puts its virtue into the buds and seeds. Farmyard manure furnishes all these elements in about the right proportions, and in a condition in which the roots can readily absorb what they want. A good cover crop ploughed in in the spring is almost equally efficacious. But it may chance that the trees need more of one or other of the three ingredients than these manures naturally supply. In that case they must be supplemented or replaced by artificial manures in varying proportions as the trees appear to need them. If you apply artificial manures only, a full dressing of each of the three elements would, as a general rule, require per acre : nitrate of soda,

200 pounds ; muriate or sulphate of potash, 250 pounds ; and raw ground bone, 400 pounds. These are the amounts for mature trees ; for young trees the amounts must be proportionately decreased. When leguminous cover crops are grown every year, the nitrate of soda may be very greatly reduced or omitted altogether. These fertilizers should be applied early in the spring, just when growth is commencing. Be careful not to overdo the manuring with chemical fertilizers ; an excessive use of them is apt to burn the humus out of the soil.

**COVER CROPS.**—Cover crops not only conserve the moisture, but they supply humus or decayed vegetable matter, a property with which British Columbia orchard soils are not too heavily charged as a rule.

Early in September, or as soon as the fall rains begin to come, sow a crop of hairy vetches, red clover, cow peas, rape seed, or other pod-bearing plant, and let it stay until the following spring, when it should be ploughed in. The quantities of seed to sow are—of red clover, 20 pounds to the acre ; and of hairy vetches, 50 pounds. It is here that the full advantage comes in of sowing a crop of clover on the land before the trees are planted at all. When they are planted after such a crop, the clover is there all ready down below where the roots go, and they get the benefit of it from the start. It is not easy to realize the immense difference there is between the growth of trees so planted and the growth of trees planted without a crop of this kind. As a rule, it is not advisable to pasture these green crops. The crop must be ploughed in if it is to serve the purpose for which it was sown. Nor must the green crop be allowed to grow too rank and

coarse before being ploughed in. If it gets too heavy in bulk, it will be too long in decaying, and instead of holding the moisture round the roots for the trees' advantage, it will use up the moisture itself, and so rob the tree.

It may be said generally of British Columbia orchard soils that they possess plenty of natural fertility, but require to have the soil worked so as to bring it into a fit mechanical condition for releasing the elements of fertility contained. This is best accomplished by the methods I have just outlined—diligent surface cultivation during the summer, followed by a cover crop in the fall, and the ploughing in of the cover crop in the spring. This will not only store up a sufficient supply of plant food, but will prepare that plant food in such a way as the tree can most readily and most easily absorb it.

For the sake of completeness, it ought to be stated that some authorities recommend clean cultivation throughout the year. Where it is possible to obtain a sufficient supply of farmyard manure, that system may with advantage be followed. But where that class of manure cannot be conveniently obtained in sufficient quantity, and this is generally the case on the small holdings throughout British Columbia, the best method of applying fertilizers to the soil is by means of the cover crop of clover, alfalfa, or vetches, ploughed in periodically in spring. If that is done whenever the trees require it, there is no need to apply artificial or chemical manures. The system of clean cultivation during the summer, followed by a cover crop in the fall and winter, will not only keep right the texture and quality of the soil, but will give the trees all the fertilizing agents they want.



## CHAPTER IX

### PRUNING

**NECESSARY TOOLS.**—For pruning fruit-trees you do not need much. The only tools you need are a pair of secateurs or pruning-shears, a double-faced pruning saw (for cutting thick branches), a pair of long-handled shears for tall branches, a pair of ordinary steps, and a small pot of thick white paint.

In broad, general terms pruning means cutting a fruit-tree with the view of (1) shaping it, (2) increasing its area of wood, (3) increasing the quantity of its crop of fruit.

**PRUNING FOR SHAPE.**—As regards the shaping of the tree, the first three or four years are those of the most importance. The first pruning a young fruit-tree receives is the cutting off of the top at the time it is planted. This will give you what is known as a low-headed tree. At present this is the form of tree that is being most advocated in the West of America, from British Columbia to Oregon. At the same time you will find some orchard men who advocate heading the young tree at  $3\frac{1}{2}$  or 4 feet above the ground. There is something to be said for both methods. With a low-headed tree you can more readily prune, spray, thin and gather the fruit. You do not require to use long ladders, but can generally perform

all the operations of the orchard from the ground, or at the most from a long pair of steps. And if you don't use long ladders, you can get women and girls to pick the fruit, and their labour is cheaper than that of an able-bodied man. The advocate of the higher-headed tree is influenced chiefly by the greater ease with which he can get his implements underneath the trees when cultivating his orchard. On the other hand, implements are now made which will project to one side underneath a low-headed tree whilst the horse walks quite clear of the branches. Besides this, when the trees begin to bear, even though headed high, the weight of the crop bends them down, so that it is difficult for a horse to move underneath them without breaking them with its head. On the whole, it seems best to keep the trees low, and never let the horse go underneath the branches.

Assuming, then, that you decide to keep your trees low, there are two shapes you may aim to produce: (1) The pyramid, growing highest in the centre; and (2) the vase, growing hollow in the centre. In British Columbia the majority of orchardists prefer the former, the pyramidal shape. The vase shape is admirable in a climate which does not get a superabundance of sunshine, as, for instance, in England. But in British Columbia the sun shines frequently so hot and with such a burning force that, unless the middle of the tree is protected to some extent with leafage, it is apt to suffer from sunscald, fruit as well as bark.

**FIRST YEAR'S PRUNING.**—One year after planting comes the pruning, which of all the prunings that the tree undergoes is probably the most important for deter-

mining its future shape. It is then that the branches must be selected which are to form the framework or scaffolding of the future tree. For this purpose choose four or maybe five of the little side branches which have developed during the course of the first year, selecting them as far as possible 6 to 8 inches apart, and nicely distributed all round the future trunk of the tree. Do not on any account have them all starting at the same place. If you do they are pretty sure to split apart when the tree begins to carry heavy loads of fruit. Cut off all other side branches, and shorten back the four or five that you keep to about two-thirds of their length, or say to a length of 12 to 16 inches. If the branches grow fairly upright, cut just above an eye that looks towards the outside of the tree. If they grow flat and almost horizontal, cut to an eye that looks towards the inside of the tree. A good example of a tree which must always be cut to an outer eye, because of its very upright growth, is Northern Spy. Of those with a spreading habit, and which consequently need to be cut to an inner eye, it will suffice to mention Jonathan. In pruning small wood of one year's growth, always cut it upwards and aslant, just below a bud in such a way that the bud sits at the top of the slant.

SECOND YEAR'S PRUNING.—In pruning the second spring after planting you proceed pretty much as in pruning the first spring, except that the branches you select for keeping will now be placed on the four or five side branches which you kept the year before. In removing all other side branches cut to a length of about 2 inches. Some authorities leave as much as 4 to 5 inches ;

but in British Columbia, where the trees naturally produce such heavy crops that we have to thin severely, and even then after thinning often require to support the limbs of the trees with numerous props, it would appear to be the more economical plan to keep your fruit spurs systematically short, and about 2 inches is a convenient length. At this time you will begin to notice a certain number of short twigs sticking out stiffly from nearly all the branches. These are fruit spurs, and must not be cut off. At this time, also, you will find that at the end of the main branches in many cases three smaller branches have been developed during the past season. If all three look as though they would grow naturally towards the outside of the tree, they may all be left. Only, in that case, shorten back the two at the side to about 10 or 12 inches each, and leave the middle one, called the leader, 15 inches or so in length. It is important that the leader should in all cases be left an inch or two longer than its own side branches, because the sap flows to the outermost tips, and they are the ones which must grow fastest, or rather grow longest, if the tree is to preserve its proper shape.

Should you at a later date discover that you have left too much wood—that is to say, too many limbs—in your tree, and find you need to cut some of them out, then cut them off close up against the branch from which they spring, and avoid leaving a short stub sticking out like a knob. If the branch you thus cut off exceeds an inch in diameter, it is best to paint it with thick white paint, so as to protect the wound from the ill-effects of the weather and from possible injury by insects.

When pruning older trees, one should always at the same time cut out any branches which may be broken or injured, or which may be chafing against other branches. All such wounds open the door to attacks of fungoid and insect enemies.

**TIME TO PRUNE.**—Pruning should be done as near to the bursting of the leaf as possible, but it must be begun sufficiently early so as to admit of the whole of the work being completely finished before a speck of green leaf appears. March is, as a rule, the month in which to prune. But pruning may be done in January and February, though in that case there are two or three practical rules to be observed. Do not prune when the thermometer registers more than 10 degrees of frost. If you have to prune thus early trees which are naturally tender, or which occupy an exposed position, do not cut just above a bud, but cut right through the bud, so as to destroy it, and select for destruction in this way a bud which grows in a direction different from the bud you want to keep—namely, the bud next below it. By doing this you will leave a short stub of wood beyond the last uninjured bud. This stub will probably die, and so leave the real extremity of the branch at the highest bud which is not destroyed. The bud you want to study and choose at an inner or outward position, as the case may be, is this bud.

**SUMMER PRUNING.**—Pruning in March (or February or January) is called “winter pruning.” Its principal result or effect is generally considered to be the promotion of wood growth—that is, the building up and development of the tree. But there is also summer pruning,

the object of which is generally considered to be the formation of fruit buds as distinguished from wood buds. Summer pruning should be done as a rule in June, July, or the first half of August, when the tips of the shoots are so tender that they can be pinched out with the thumb and finger. If the operation is performed just at the right time—and the essence and virtue of the operation lie just in this, doing it at the right time—the little branch will produce fruit spurs and fruit buds, and so not waste energy in producing wood which will have to be cut away in the winter pruning. Just what makes a tree fit for summer pruning is a matter that can only be learned from practical observation and actual practice.

In certain districts the practice of summer pruning is being discountenanced by experienced growers.

## CHAPTER X

### SPRAYING—THINNING

SPRAYING.—Spraying—at all events, the first spraying of the season, with lime and sulphur—should, like pruning, be performed when the tree is dormant, and before any sign of a green leaf appears. We spray our fruit-trees, partly to prevent the attacks of fungus and insect enemies, and partly to administer a tonic to the trees. If we had any fungus or insect pests to fight against—fortunately, we have none worth speaking about in British Columbia—we should have to spray in order to destroy them. Many growers spray only once, with the lime and sulphur solution, mixing 1 gallon of the spray with 11, 10, or even 9 gallons of water, applying the spray warm when the trees are dormant, before ever a sign of greenness appears. The spray must be thrown on to the trees with some sort of a force-pump, and must be made as fine as mist. It is of the utmost importance that each tree be sprayed thoroughly, every twig and branch being well covered all over. If not done with perfect thoroughness, spraying fails of its object, and might as well be left alone.

Immediately this spraying is finished, be sure to rake carefully together all the prunings—that is, the twigs and branches which have been cut off in pruning—and burn them.

**SPRAYING FORMULÆ.**—For combating the diseases and insect and fungoid pests which occur in British Columbia orchards the fruit-grower will find the following formulæ are all that he requires to know, as they will meet all and every sort of trouble that has hitherto been detected in the orchards of the province :

1. *Lime-Sulphur Solution.*—This can be bought ready-made in quantities from 5 gallons up to 40 odd gallons, at a cost of something like 10 to 15 cents per gallon. The Niagara spray and Pendray's are both satisfactory. If the fruit-grower prefers to make his own spray, the ingredients are : Unslaked lime, 40 pounds ; sublimed sulphur, 20 pounds ; coarse salt, 10 pounds ; water, 50 gallons. Each of the solids should be mixed separately with hot water, then poured together into one vessel, each being strained through wire gauze. Even then the pump and nozzles will clog. Pendray's spray may be applied lukewarm ; home-made spray should be put on at a temperature of 130° F.

2. *Double Bordeaux Mixture.*—The ingredients are—Sulphate of copper, or bluestone, 8 to 10 pounds ; unslaked lime, 8 pounds ; water, 50 gallons. Pour boiling water over the bluestone to dissolve it, and use a wooden, not a metal, vessel. Make it up to 25 gallons. Dissolve the lime separately, also with hot water, and also make up to 25 gallons. Then into a third vessel pour the two mixtures together simultaneously, so as to mix them well. This spray must be used within twenty-four hours. After that time it begins to decompose. For leaf-eating insects add to this spray Paris green at the rate of 1 ounce to 10 gallons of the lime-bluestone solution. Keep well



stirred after the Paris green is put in, as it will not dissolve.

3. *Arsenate of Lead*.—With 40 gallons of water mix 3 pounds of arsenate of lead, which is a paste. Use rain-water, and mix thoroughly.

4. *Whale Oil Solution*.—Whale oil soap, 7 pounds ; quassia chips, 8 pounds ; water, 100 gallons. Boil the quassia chips for one hour ; dissolve the soap in hot water. Strain each, then mix together and make up to 100 gallons.

The purposes for which these several sprays are used will be made plain in the next following chapter.

SPRAYING IMPLEMENTS.—For spraying small orchards or small trees it is sufficient to use a hand sprayer, a tin cylinder some 22 inches long, which a man can sling on his back or under his arm. After putting in the spray solution, you pump in air by means of a pump, which forms part of the apparatus. This gives a pressure, and when you open the valve the liquid spray comes out with great force. Its fineness is regulated by the nozzle. It is of the utmost importance that all sprays should go on to the trees in as fine a mist as possible. That and thoroughly covering every part of the tree are the secrets of success in this operation.

In larger orchards and for larger trees some sort of spray pump fixed on wheels, or a sort of sleigh for steep slopes, must be used. One man drives the horse and pumps, a second man holds the rubber pipe with the nozzle on it and directs the spray. A bamboo rod can be attached to the end of the rubber hose to give a more efficient control over the direction of the spray, and to enable the operator to reach the inner recesses of larger

trees. In large orchards, and for applying spray for codling moth, it is necessary or desirable to use some form of force-pump, driven generally by a gasoline engine.

**THINNING.**—In British Columbia orchards this is almost invariably a necessary operation. The first thinning should be done in June. In years of good crops a second thinning will have to be done in July, and maybe a third in August. At the first thinning take off all badly shaped and all faulty fruit, and do not leave three apples anywhere that hang in one cluster. Leave at most two, though one of these may have to be taken off at the second thinning. When the work is finally completed the separate apples should, on reaching full size, each hang 1 or 2 inches distant from its nearest neighbours on each side of it. But if the tree is carrying only a light load, two apples may be left on the same branch, provided each has plenty of room to develop to full size uninjured by the other. Judicious thinning will not diminish the total weight of the crop at the time of gathering the fruit, but, on the contrary, tends to increase its weight. It has the great advantage of leaving fruit of a more uniform size, and larger, and with a much smaller percentage of faulty apples. In those cases where the middle one of the three apples which grow nearest the tip of a branch presents a different appearance from its two companions, as in McIntosh Red, it is, as a general rule, this middle apple which will give the typical shape for the variety. But do not hesitate to take it off if it already shows any defect.

## CHAPTER XI

### INSECT PESTS—DISEASES—REMEDIES

As yet the orchards of British Columbia are commendably free from the worst and most dangerous enemies of the insect world. Neither San José scale nor the apple-worm (codling moth) has got a footing in the province. Certain fungoid diseases and certain diseases which appear to owe their origin to peculiar conditions of the weather in spring are the principal enemies that the British Columbia orchardist has to fight against.

**INSECT PESTS.**—The *Tent Caterpillar* makes his appearance almost every year in some part or other of the orchard. You will detect him by his whitish-looking net or web hanging near the end of a twig, or by observing all the leaves eaten off on some slender branch. As soon as you see this web, cut it off with all the caterpillars—smallish black creatures with coppery-yellow spots all over them—inside it and burn it. You must cut it off early in the morning or else after sunset. During the day many of the caterpillars will be away from home foraging amongst the branches of the tree.

*Oyster-Shell Scale*, or *Bark Louse*, is a minute organism shaped like a tiny sickle which sticks like a limpet close to the bark of the tree. The insects themselves are hidden under the shells, and are only active for about three weeks

in the year. A thorough spraying with the lime-sulphur solution to the strength of 1 gallon of solution in 9 gallons of water at the usual time of using this spray, followed after a few days by a second application of 1 gallon of solution to 10 gallons of water, will put an end to this trouble.

For various kinds of apple-worms and any caterpillars or other leaf-eating insects, use the arsenate of lead spray. Use this immediately after the blossoms fall. Be careful to fill the calyx cup, where the blossom was, quite full, and to cover completely every bit of the young fruit and foliage. If a second spraying is needed, do it ten days later. For green fly, brown fly, black fly, and all other kinds of aphides, use the whale oil soap, generally in July. You can readily detect their presence by observing the leaves beginning to curl at the tips of the branches, and by the foliage generally losing freshness, becoming sticky and shiny, and appearing to shrivel in size.

*Cutworms.*—These creatures do not as a rule attack fruit-trees, though occasionally, I believe, they do climb into quite small trees. They are smooth-skinned, dark brown caterpillars, about an inch long, which begin their fierce depredations about May, and continue them for that month, for June, and sometimes on into July. They are very destructive, especially to crops growing on newly broken ground. They feed by night, and during the day hide in the ground at the foot of the plant they are preying upon, an inch or so below the surface. The crops they love most to attack are young cabbages, cauliflowers and similar greens, tomatoes, lettuce, and

so forth. On the other hand, they are easily checked. Bran, poisoned with Paris green and sweetened with molasses, syrup, or sugar and water, has an irresistible attraction for them. Mix 5 pounds of sugar, dissolved in water, and 1 pound of Paris green in 40 pounds of bran, and stir until it will just stick together in lumps. Then place a tablespoonful near each plant attacked, and relief will come very speedily. Poultry must be kept away from this; if they eat it, they, too, will be poisoned.

**FUNGOID DISEASES.**—The principal diseases of this kind that attack apples in the interior of British Columbia are scab and peach-leaf curl. Both can be controlled by using the Bordeaux mixture (bluestone and lime).

**OTHER DISEASES.**—Under this heading we may group Baldwin spot, water core, and anthracnose or canker. Baldwin spot, or dry rot, is that disease in which little round depressions of a deeper colour than the apple generally appear in the skin just about the time the fruit is ripening. Their specific cause is not known, but they may be kept in check by proper cultivation and regulation of the crop. Spraying has no effect. The same remarks apply to water core, or the waxy, watery appearance which the core presents sometimes, especially in certain earlier varieties, such as Red Astrakhan and Ribston, and in Jonathan if left on the tree too long after it is fully ripe. Some authorities state that water core only comes when the fruit is not gathered soon enough.

Anthracnose, or canker, is closely allied to sun-scald, which appears when, owing to faulty nutrition or some interference with the flow of the sap, the sun scalds the

bark and sets up decay. Sun-scald often causes the bark to split and crack open. This is especially true of fruit-trees planted at high altitudes owing to the very hot days followed by cold nights. Anthracnose does its deadly mischief underneath the bark, and causes a hollow space to come between the bark and the stem. If this is cut open, it will be found to contain a semi-liquid gum or sticky exudation. This must be very carefully scraped away and very carefully burned, and the wound painted with liquid corrosive sublimate.

Cherry-trees are very subject to an exudation of gum, known as *gummosis*. This seems to be due to a variety of causes, or at any rate a variety of causes contribute to its appearance. If the exuding gum is hard, it will not do much real harm. If, however, it is soft and gum-like in consistency, it should be carefully scraped away and burned, and the wounds painted with corrosive sublimate.

## CHAPTER XII

### IRRIGATION

SHALL I buy irrigated or non-irrigated land? Which gives the better results? are questions which almost every man who contemplates growing fruit in British Columbia puts to himself sooner or later. And they cause him as much cogitation, maybe more, as does the problem as to whether he shall buy improved or unimproved fruit land.

This is a thorny and delicate subject, and no matter how you treat it, you are pretty certain to offend one side or the other. To avoid friction as far as possible, I will confine myself to quoting the opinions of American experts, and to citing no facts except such as cannot be disputed. In the first place, I will quote two of the foremost horticultural authorities of the American West as to the real necessity for artificial irrigation. Professors C. I. Lewis and W. H. Wicks, of the State Agricultural Experiment Station at Corvallis, Oregon, said, writing on "Orchard Management" in the American journal *Better Fruit*, for December, 1907 (p. 11): "In certain locations, like Rogue River and Hood River, we find just as fine fruit grown without irrigation as with it, although certain areas doubtless would be benefited by irrigation. . . . On moderate heavy loams we find that we can grow

apples that keep longer than on light loams, where apples naturally mature more rapidly, and consequently have a shorter life. This fact has led some to conclude that the irrigated apple is a superior keeper. On the contrary, where fruit is heavily irrigated, we find that size is gained, but flavour, aroma, keeping and shipping qualities are sacrificed. . . . Before irrigating on a large scale, be sure you need it. Many times more thorough cultivation is what is needed; if you do irrigate, remember that the problems concerned with irrigating your fruit are vastly different from those connected with cereals, forage crops or garden truck [vegetables]. You must know how much water to apply, when to apply, and the action of water on tree, fruit, and soil. It takes less water if it is added in the form of one or two good applications, thoroughly wetting the soil, than a great number of times, but in small amounts. . . . Applied, say, mostly in July, better all-round results are obtained. At times one would be justified in adding water in the fall, but not as a general practice. Whenever irrigation is resorted to, it should be followed by thorough cultivation. . . . Wherever land is irrigated it should be well underdrained, thus preventing the accumulation of injurious salts or acids. Irrigation has a tendency to prolong the growing season, at times producing a secondary growth. . . . Whenever this practice of late irrigation is employed, the twigs and buds do not seem to harden properly, and in case of a hard freeze they are liable to be injured, and the result will be a light apple crop."

The second authority whom I will quote is Mr. E. H. Shepard, sometime manager of the Hood River Apple-



Growers' Association, now editor of *Better Fruit*, the best horticultural journal published in America that I am acquainted with, himself a practical fruit-grower of several years' experience, and a very successful exhibitor at the principal apple shows during the last half-dozen years or so. In the February (1908) issue of his magazine he wrote (p. 18) : "In order to get the best results, both as to yield and size of fruit, it is necessary to keep the orchard under perfect cultivation, so that the soil will be properly pulverized. A thorough state of cultivation is necessary in order to enable the rootlets to get their food from the soil, and it is also necessary in order to conserve the moisture, which is absolutely necessary for the growth of the tree. Moisture can be supplied by irrigation, but while Hood River Valley is blessed with three irrigation systems, and therefore has an ample supply of water, very little water is brought into our orchards. Most of the growers will not water an orchard until the trees come into bearing. We claim the roots go deeper if not irrigated, and therefore get a bigger area of soil. After an orchard comes into bearing, even then many fruit-growers do not irrigate, and few irrigate more than once a year. We believe that the less water an apple has, the better the flavour will be, and we feel equally convinced that the apple that is not irrigated, or only is irrigated once during the season, will keep longer than the one irrigated more frequently."

Accepting these statements as true, and they cannot well be doubted, it is surely consistent with common sense to conclude that, if you can grow your apples without irrigation, that is the best plan ; but if you have to

depend upon irrigation, then use the water as seldom as possible. I would add that each time you do use water, use it thoroughly. Do not just wet the surface and so bring the delicate fibrous roots up to the top of the ground for them to get scorched by the hot sun, but give a thorough watering, so that the water will go down below the roots, and the roots will go down after the water. The real objections which non-irrigating fruit-growers have to irrigation is the additional cost it makes to the general costs of producing a crop, a charge per acre which is imposed for all time to come, without any hope of ever getting relief from the burden. Moreover, if there is any possibility of the available water-supply running short, to that content there exists the possibility of further expense having to be incurred in bringing in additional supplies, or of the rancher having to go without water just at the critical time when he needs it most.

But whilst it is better to grow fruit without artificial irrigation, it is at the same time wise, even in the non-irrigated districts of British Columbia, to make provision, by flume or reservoir or well, for a supply of water, suitably placed, against the dry months of July and August. What may chance to need an application of water at that season is not the older and well-established trees—they can generally look after themselves without artificial irrigation—but the quite young trees which have not yet sent their roots far down into the ground, and the surface crops, such as strawberries, clover, potatoes. A judicious supply of water given to quite young trees in July, and again in August, will keep them moving and prevent a check that might be hurtful to them. You

will remember what Mr. Shepard says just above about the contrary practice in the Hood River ; there they do not irrigate the young trees, but they do occasionally irrigate the bearing trees. Professor C. I. Lewis tells us (*loc. cit.*) that " in the Grand Ronde Valley young orchards up to the time of heavy bearing seem to do very well without any irrigation, but heavy bearing orchards seem to need several irrigations in order to mature a heavy crop of large apples. In the Willamette Valley cultivation is all that is required."

The danger which chiefly threatens when irrigation is used in excess is the accumulation of alkali or injurious salts in the upper layers of the soil. To counteract this, drainage is necessary, to wash out and so cleanse the soil. If the soil gets packed and hard, as it tends to do under constant irrigation, the land must be ploughed deep in the spring.

The fact of the matter appears to be that in British Columbia, equally whether your orchard is situated in an irrigation or in a non-irrigation district, it is wise to have command of water against the height of the summer. The costs of irrigation water, therefore, equally whether you pay a water tax annually or put in your own works (well, dam, pipe, flume, or what not), must be regarded as an insurance against adverse seasons. If, then, you are able to command a sufficient supply of water precisely at the time you want it, and if you possess the necessary experience to use it aright, you need virtually be under no anxiety as to a crop failure.

The sole objection to irrigation that remains is the inalienable nature of the burden, which, because of the

very fact that it can never be escaped from, makes it in the long run more costly to grow fruit in that way than it is to grow it in a non-irrigated district, where the expense of providing a reserve supply of water is an expense incurred once for all, and an expense which requires an incomparably smaller amount of capital, as the works for storage and distribution are always on a very much smaller and less elaborate scale. The rancher should place his main reliance upon thorough and properly executed cultivation, no matter which kind of district his orchard is situated in. Fruit of equally fine quality is grown under both sets of conditions, as the results at the principal great apple shows clearly and unmistakably demonstrate, especially when the extent of the areas drawn upon in the two different kinds of orcharding are properly taken into account and duly allowed for.

## CHAPTER XIII

### MARKETING

THE producing of apples is a comparatively easy accomplishment, as any even the most neglected and uncared for of English orchards can sufficiently demonstrate. But to produce year after year a sufficient crop of apples of really good quality, equal to the best recognized commercial standards, is a very different thing. No art can be more difficult, no art requires a higher degree of skill or a more alert and more flexible intelligence. No art requires closer and prompter attention, and more effective application of labour; and, also, no art is more fascinating. But when you have grown apples that will bear the scrutiny of the modern commercial standards, you still have facing you what is undoubtedly the most difficult and delicate part of the fruit-rancher's calling. You still have to market your crop, by selling it at the best price.

Now, owing to the geographical position of British Columbia and the distribution of population over the world, this province must of necessity be an exporter. The fruit-growers must sell their produce in markets which are in many cases thousands of miles distant, and in all cases are several hundred miles removed from the localities in which their apples are grown. As yet the

annual production of the entire province is, comparatively speaking, of no more effect on the volume of the world's fruit markets than the outflow of the Mississippi is upon the volume of the Atlantic Ocean. It is perceptible, it is true, but proportionally it is as nothing in amount.

**MARKETS.**—The Canadian prairies are the nearest markets—markets which are growing at a wonderfully rapid rate both through immigration and through the natural increase of the population. And these are markets which, owing to the rigorous winter climate that prevails generally, can never expect to be satisfied by local supply. Here British Columbia fruit-growers have already gained a good footing with their small fruits, such as strawberries and raspberries. But the quantity of apples sent into the prairie provinces from British Columbia is as yet extremely small. Nevertheless, such apples as do go are beginning to command better prices than the American apples which come into competition with them. The reason that so few are sent is simply that British Columbia does not produce a sufficiently large quantity. Except for the Okanagan Valley, a few localities in the Fraser Valley, one or two places on Vancouver Island, and the district of Grand Forks, none of the larger fruit-growing regions of British Columbia are yet in a position to send out a whole carload at one time. The day is fast approaching, however, when every fruit district and subdistrict will be able to do this. It was not until 1903 that the first carload of British Columbia apples was sent to England. Since then a few, but only a few, tons have been sent over every year; and during the last few years

small shipments have gone to Australia, chiefly from the Okanagan Valley, and also from Grand Forks.

At first, as I have already said, the fruit-grower who is still new to the business will be wise to sell through his local Fruit-Growers' Association. Individuals can and do ship out their own produce to the prairie towns; but they need to be sure of their ground, and equally sure of themselves—namely, that they can guarantee nothing but perfectly satisfactory fruit, and see that their guarantees are conscientiously carried out. There are no established markets in the smaller towns, and customers are obtained there only by personal private arrangement. In the larger towns there are wholesale fruit dealers and agents to whom fruit may be sent, in some cases to be bought by these firms, in other cases to be sold by them on commission. The firms to whom the fruit is consigned will nearly always pay the freight or express charges on delivery.

The Old Country, especially such large towns as London, Liverpool, Manchester, Glasgow, and Belfast, are all eager to buy British Columbia apples, but it is comparatively few that British Columbia is able to send them.

Another clamorous customer is Australia. In 1908, and again in 1911, she made a legitimate business demand for 100,000 boxes of British Columbia apples. On the former occasion it was for 100,000 boxes of Wealthy. At that date the entire province did not produce 100,000 boxes of all varieties of apples put together, let alone of the one variety of Wealthy. In 1911, British Columbia sent, I believe, something under 5,000 boxes, or not one-twentieth of the quantity demanded.

Almost everywhere throughout the province there is a good local demand for fruit, a demand which even now has to be met to some extent by importations from the outside, chiefly from the United States. The prices which rule in these local markets are for the most part higher than the prices which British Columbia growers could obtain by exporting their fruit. The principal exception to this is the very choicest apples, which make considerably higher prices in the markets of the Old Country.

Inquiries for British Columbia apples have also been made during the last season or two by importers in Germany (Hamburg), South Africa (Johannesburg), Holland, Sweden, Norway, Belgium, China, and Japan.

With a growing and widespread network of markets like this there is no fear of over-production for many years to come. In the United States, where the population has grown fast, the total production of apples decreased from 69,000,000 barrels (3 bushels in each) in 1896 to less than 24,000,000 in 1910. The Americans eat per head more apples in the year than any other nation. If the British Columbia fruit-grower will continue to be worthy of the expectations that the world has of him at the present time, and will aim to produce fruit of real sterling excellence, competition, even though it grow fast, will not hurt him. It will only serve to enhance and set forth in stronger relief the superlative merit of the commodity which his peculiarly happy climate enables him to produce.

**EXPRESS AND FREIGHT.**—By freight rates the railways in Canada mean the same thing as the English railways do when they talk about goods rates. Larger



consignments, such as potatoes, apples, and any produce sold by the carload, would naturally be "shipped," as the term is, by freight. Small fruits, and all perishable fruits, such as strawberries, are mostly shipped by express—that is, by the ordinary passenger trains, and, of course, at higher rates.

**PACKING.**—For the first few years the only fruit which the rancher will have to send away will be small fruits. Consequently some time must elapse before he needs to understand the mysteries of packing apples, pears, plums, or cherries. There will be ample time for him to learn all about these operations during the years his trees are growing up. He should by all means attend the nearest apple-packing class; by that means he will learn for a cost of (at present) \$3 all that he will require to know. So far these classes have been held at the end of winter.

Strawberries, gooseberries, red and black currants, blackberries, and raspberries, are all packed in exactly the same way. They are gathered into small square chip baskets, known as hallets, punnets, cups, and other names, and twenty-four of these are packed in a wooden crate for shipment by rail. Except in the case of strawberries, the actual packing is all finished when the fruit is placed in the punnet, which must be filled quite full in order that it may weigh 1 pound. In the case of strawberries it is usual to arrange the top layer in each punnet in regular even rows, hiding all the stalks. This is called "facing," and is best done under a roof, out of the hot sun. In order that room may be left in the punnet for this top layer, it is best for the pickers to fill the punnets into which they pick the fruit only about three parts full;

no very small strawberries must be put in the punnets. All the fruit should be of a fair average size. It is most important that the strawberries should stand a few hours in a cool place before being placed upon the train, so that the sun's heat may gradually pass out of the fruit. The same rule applies to all the small fruits, and to cherries.

Every box or package of fruit which is offered for sale must bear the name and address of the packer or grower stamped on it, also the name of the fruit and the designation of the grade or quality. Infringement of this regulation is punishable by a heavy fine. The law is by no means a dead-letter.

## CHAPTER XIV

### GOVERNMENT ASSISTANCE

IN so far as the fruit-grower's industry in British Columbia is capable of being influenced by the authorities, he has every reason to thank his stars. Not only the Dominion Department of Agriculture, but the Provincial Department too, are fully alive to his interests. Both bodies study his needs and strive even to anticipate his wants and his requirements. He does not find it necessary to be perpetually bombarding them with petitions, repeated *ad nauseam*, before he can procure even a hearing. Frequently he only becomes aware that a certain requirement existed by finding one or the other department knocking at his door with the remedy or fulfilment in its hand. Special thanks are due to our own Provincial Department of Agriculture. No man could be more alive to the interests of the fruit industry than the present Deputy-Minister, Mr. W. E. Scott, in whose hands the care of this particular branch of agriculture in British Columbia is placed. He is fully alive to the great importance which the industry is destined to have on the development and fortunes of the province, and spares no pains to inform himself as to the efficacy of new methods, new improvements, and new devices. In fact, he is always on the alert to study any project

or plan that is calculated to further the progress of the calling. It is not altogether a mere figure of speech to say that, if the rancher only takes advantage of all the opportunities which the Provincial Government places in his way, he can obtain a fairly comprehensive horticultural education in the course of a single year.

PROVINCIAL HORTICULTURISTS.—In each of the more important districts into which the province is divided for horticultural purposes the Board of Agriculture has stationed a trained and expert horticulturist. His duties are to lecture on subjects connected with orchards ; to give practical demonstrations in the open air of planting, pruning, spraying, and so forth ; to act as judge at local fruit shows ; to manage the demonstration orchards (*vide* below) ; and to advise generally on all matters connected with horticulture in his district—both advise the growers as to how they shall conduct their operations and assist the Board of Agriculture by furnishing it with information. The number of these officers is being gradually added to as the area under orchards extends. At the moment of writing there are six of them, stationed respectively at Nelson, Grand Forks, Vernon, Kamloops, and Vancouver Island, with a general horticulturist at headquarters in Victoria.

LECTURES AND DEMONSTRATIONS.—Every winter and very frequently in other seasons as well the horticulturists and other experts give lectures at quite a large number of centres on such subjects as soils, orchard management, planting, pruning, spraying, manures, poultry, and so on. From time to time distinguished professors of horticulture and fruit-growers of mark from Eastern Canada



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and the United States are invited to tour the province and lecture in the chief fruit-growing districts. All these lecturers, even the college professors, are men of the open air, not mere students of the desk. They are first and foremost practical men. Some of them are actually earning their living in the callings about which they are engaged to lecture. And along with lectures go demonstrations in the orchards themselves, in so far as the season is favourable for them.

**DEMONSTRATION TRAINS.**—Quite recently the agricultural authorities of Washington and other American States have sent a body of lecturers on a tour round the State, who not only talk, but actually demonstrate from the train itself by which they travel. They have a fruit-tree standing on a flat or open car, which they use to illustrate the operations of pruning and spraying, though they are quite ready to demonstrate on any tree which happens to be growing conveniently near to the spot where the train stops. In another car are a good milch cow and a beef ox, by means of which the lecturer points out the respective merits and desiderata of the two types of animal. In another car are poultry; and in a fourth ladies lecture on the various branches of domestic science. The British Columbia Board of Agriculture proposes to organize a similar travelling school of lecturers for the coming summer of 1912.

**DEMONSTRATION ORCHARDS.**—During 1911 the British Columbia Board of Agriculture selected a large number of 5-acre orchards all over the province, to be managed and cultivated under the supervision of the Provincial Horticulturists, and in part at the expense of the Pro-

vincial Government, as small model orchards for the benefit of the districts in which they are situated. In addition to these there is a Dominion Experimental Farm of the usual type, in which all branches of agriculture are dealt with, situated at Agassiz, in the Upper Fraser River Valley. This farm, as well as the principal Experimental Farm of the Dominion at Ottawa, distribute seeds of vegetables and farm crops gratis in small lots to any farmer or rancher who cares to make application for them.

FARMERS' INSTITUTES.—In many of the smaller fruit-growing localities the ranchers organize themselves into a farmers' institute. To these bodies the Provincial Government sends lecturers and issues reports and bulletins to the individual members. The members also combine to purchase in bulk spraying materials, fruit-boxes, manures, and so forth, for distribution amongst themselves, thus saving middlemen's profits.

GOVERNMENT INSPECTION.—With the view of protecting the fruit-growers of British Columbia against unfair competition, all fruit brought into provincial markets for sale is subject to inspection, and condemnation if it fails to come up to the standards and requirements of the Dominion Fruit Marks Acts. Both Boards of Agriculture, Dominion and Provincial, carry out the duties of inspection, and certainly the regulations are not allowed to lie fallow.

Again, in order to preserve the orchards of the province as far as possible free from insect and fungoid pests, all nursery stock, of whatever description, is subject to rigid and close examination upon its entry into the province. Every year many thousands of young fruit-trees are



destroyed as being infected. Those which are found free from infection are severely fumigated before being sent on to their destinations. These measures are applied to nursery stock brought into British Columbia from other provinces of the Dominion equally as to nursery stock which is imported from the United States and elsewhere.

**PACKING SCHOOLS.**—Every winter since the winter of 1909-10 the Provincial Board of Agriculture has held apple-packing schools at numerous fruit centres in the province. In addition to these classes, apple-packing contests are held in public at several of the local fruit fairs. Two classes of diplomas are issued to the more skilled of the pupils who attend these apple-packing schools—ordinary diplomas, which certify to the pupil's proficiency, and commercial packing diplomas, which not only certify to the pupil's proficiency as a pupil, but also guarantee that he has packed for at any rate one season in a satisfactory way for some well-known fruit-grower or Fruit-Growers' Association. It makes him, in fact, a professional packer.

**GOVERNMENT GRANTS.**—The Government of British Columbia is in the happy and probably unique position of having an annually increasing surplus of revenue over expenditure. This enables it to be generous to various young industries. Amongst others, that it benefits substantially by direct money grants is the fruit industry. Considerable sums are given every year to the funds for providing prizes at the local fruit fairs throughout the province. The prizes, which are competed for at the apple-packing contests, are provided by the Department of Agriculture. This same Department collects and

exhibits every year specimens of packed fruit of every kind grown within the province, as well as vegetables, at the principal fairs all over the Dominion, buying their exhibits direct from the growers. It also sends fruit almost every year to Britain, exhibiting at the Royal Horticultural Society's shows and in the principal towns of the country ; and is also represented at almost every other important fruit exhibition throughout the world, from New York to Australia.

**SUPERVISION OF INDUSTRY.**—Spraying is enforced through the periodical visits of orchard inspectors. Proper packing is enforced by another body of inspectors, who see that the fruit is properly graded, is quite sound and free from defects, is properly packed, and that the contents of the boxes correspond accurately to the descriptions on the outside.

**BULLETINS.**—From time to time the Provincial Department of Agriculture issues very valuable bulletins on Insect Pests, Varieties to Plant, Poultry, Bee-keeping and other subjects useful to the rancher. During the fruit season the Dominion Department of Agriculture issues every month a brief summary and report of fruit prospects in every fruit-growing district throughout the country, the information being gathered from numerous representative growers in each district.

## CHAPTER XV

### CLIMATE—DOMESTIC DETAILS

CLIMATE.—Almost everywhere in the interior of the province the climate is healthy in the extreme. It is chiefly characterized by hot dry summers; cold dry winters; a comparative absence of wind; and a wide daily range of temperature. The days in summer are, generally speaking, bright and sunny; yet, owing to the dryness of the atmosphere, the heat is seldom close and hardly ever oppressive. The nights are invariably cool and pleasant. In winter there is a considerable amount of sunshine. Snow falls, as a rule, shortly before Christmas, and remains until the middle of March. Although there are snowfalls earlier, the snow does not as a rule stay. Sharp frosts come off and on from October, occasionally even in September; but from the middle of December to the middle of March the ground is mostly frost-bound. The air is usually dry and still, and the cold is not felt at all severely, except when a blizzard sets in. But blizzards are, happily, rare, the average being two or three days a year. When they do blow, the wind is very keen and penetrating, and the thermometer nearly always drops below zero. At other times the thermometer ranges between 32° and about 5° or 6° F.

The rainfall, including snowfall, which is calculated at

the rate of 12 inches of snow for 1 inch of rain, is very light all over the interior of the province. In the Okanagan it averages 11 inches; in the Kootenays, 21 to 26 inches; on the coast, 60 to 70 inches annually.

But in both winter and summer there are abrupt and sudden changes of wind and temperature, though these changes do not as a rule last very long. The difference between the thermometer at noon and at the midnight following is sometimes as much as 40° F. The maximum record for summer is about 90° F., and the minimum for winter ranges from 2° to 26° below zero in the fruit-growing districts.

On the Pacific Coast the temperature runs very much higher all through the year; the rainfall is very much heavier, in some districts very heavy indeed (140 inches); and there is more wind.

HOUSES.—Most houses are built of wood, and covered with shingles or slates of sawn cedar. Nearly all are provided with verandas, which keep the lower rooms cooler in summer. A log house, the chinks between the logs plastered with clay or cement, is warm and cosy in winter, and cool in summer, and is inexpensive to build. Every house should be provided with a good underground cellar, cemented if possible, in which to preserve perishable foods and supplies in the winter. If many green crops and roots—*e.g.*, potatoes, turnips, carrots, cabbages—are grown, it will be necessary to construct an outdoor cellar in which to store them during the winter. This is best made in an earthen bank, and should be cemented inside and covered with earth.

The houses are heated with stoves, which burn wood,

sometimes coal. But the larger houses are heated by hot water, circulating in iron pipes and radiators, or by hot air, the furnace being placed in a cellar underneath the house. A plant of this kind costs from \$500 up. Many of the newer houses are provided with one or more open hearths.

CLOTHING.—People in British Columbia wear pretty much the same clothing that they do in the Old Country. The principal differences observable are that gloves are more generally worn for working both in summer and in winter. Broad-brimmed hats are universal in summer, as protection against the sun. Leggings are not worn.

In winter for working amongst the snow the best equipment for the feet is thick woollen stockings and coarse rubber shoes. Many men wear boots with very long tops, reaching half-way up to the knee. A thick reefer jacket—a Mackinaw—is preferable to a long, heavy overcoat. For travelling in the mountains in winter, snowshoes must be worn. In very sharp frost it is desirable to protect the ears with some sort of lappets.

It is not advisable for people leaving the Old Country to bring their household furniture with them, except, maybe, pictures, books, silver, and table and bed linen. But they should bring plenty of personal clothing, especially for winter wear, and a good supply of half-worn suits.

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