AGRIC. DEPT.

Mar 1891
Agric. Dept.

0.44-53

PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF AGRICULTURE

Irrigation in British Columbia

BULLETIN No. 44

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA

*PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.*

VICTORIA, B.C.:

Printed by William H. Cullen, Printer to the King's Most Excellent Majesty.
1912.

PRACTICAL
INFORMATION
— ON —
IRRIGATION
— FOR —
BRITISH COLUMBIA
FRUIT GROWERS

By B. A. ETCHEVERRY

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B. C.:

Printed by William H. Cullen, Printer to the King's Most Excellent Majesty.
1912.

S/41

A 4

20.44-53

Main Lib.
Agric. Dept.

AGRIC. DEPT.

U.S. DEPT. OF AGRICULTURE

Practical Information on Irrigation for British Columbia Fruit Growers.

INTRODUCTION.

In proportion to the extent of agricultural land suitable for irrigation in the arid or semi-arid part of British Columbia, the water supply available is probably more abundant than that of most of the arid regions of the states of the United States, but it is also no doubt true that there are many districts where the supply is either not sufficient or else not available at a reasonable cost to irrigate all agricultural soil which needs irrigation to make it productive. It is therefore important that the available water supply be conserved and used with care and economy in order to cover as much land as possible. This may be done by supplementing the natural flow of the streams by storage reservoirs and by preventing the waste of water.

Measurements made in the United States show that on most irrigation systems consisting mainly of unlined canals excavated in earth, the losses in conveyance from the leaky ditches amounts to about 50 per cent. of the water diverted from the source of supply, and of the remaining 50 per cent. from one third to one half is lost by evaporation, percolation and other wastes due largely to crude methods of irrigation.

Storage reservoirs have been built on many of the streams to increase the water supply. A few irrigation companies are lining their canals with concrete, or using wooden flumes and pipes for their distributaries to stop the conveyance losses of water. This practice will increase the water supply available for new lands, but there will still remain the waste which occurs when water is applied to the land by a careless irrigator or one who does not know the practice and methods of skilful and economical irrigation.

Irrigation in British Columbia with the exception of a few isolated cases, is new and the methods of conveying water to the land and of applying it to the soil are in many cases crude and wasteful. The average irrigator is not interested to the same extent as the irrigation company in saving the water to use it on new land, especially if he pays for the water at a fixed rate per acre and not for the quantity actually used, or if he has an early water right which permits him to use and waste all he desires. But there are other reasons why the irrigator or fruit grower should use water skilfully and economically. First, because if water is valuable and is sold according to the amount used, the elimination or decrease of waste will decrease the water bill. Second, careless and wasteful use of water is liable to cause water-logging of lands not properly drained. Third, it is possible to use an excess of water which will interfere with plant growth and affect the fruit.

For these reasons the writer has attempted to put together information which he hopes will be of value to the new settlers, present fruit growers and to irrigation companies. The information is given under the following topics:

1. Selection of an irrigated farm and laying out orchard.

2. Units of measurement of water and methods of measuring water.
3. Methods of conveyance of water.
4. Duty of water and factors influencing the correct use of water in irrigation.
5. Irrigation and cultivation of orchards.
6. Irrigation of potatoes.
7. Irrigation of alfalfa.
8. The use of small pumping plants for irrigation.

The writer has not attempted to take up questions which are purely agricultural or horticultural and wherever information along those lines is given it is because of their relation to irrigation.

During the summer of 1911 the writer at the request of the British Columbia Government, visited many of the irrigated districts of the province. On two other occasions he has visited the districts in the vicinity of Kamloops and Summerland. This experience has been of great value in selecting for this bulletin information based not only on personal experience and observation, but also on the best practice in the irrigated districts of the United States. Because of the similarity in conditions of the fruit growing regions of British Columbia and those of northwestern states of the United States such as Oregon, Washington, Idaho and Montana, the practice in those states has been given more weight. The writer has not limited himself to his own experience, but has drawn freely from authoritative sources, especially the bulletins of the Irrigation Investigations Office of the U. S. Department of Agriculture and the bulletins of the Agricultural Experiment Stations of the various western states, for which due credit has been given in all cases.

I.—SELECTION OF AN IRRIGATED FARM AND SETTING OUT ORCHARDS.

SELECTION OF AN ORCHARD OR FARM UNDER IRRIGATION.

The intending purchaser should select his land only after he has made a careful investigation of all the requirements necessary for a good farm or orchard. The factors which he should consider are:

1. Climatic conditions.
2. Chemical composition of the soil.
3. Texture of soil and subsoil.
4. Location and site of orchard.
5. Surface conditions.
6. Drainage.

1.—Climatic Conditions.

These include precipitation and its distribution, temperature, wind movement, length of growing season, etc. A study of the rainfall and its distribution will show whether irrigation is necessary or only desirable. The rainfall, no matter how large during the year, is generally deficient during the growing season and there are very few localities which can not be benefitted by irrigation. This is well shown by the extension of irrigation in fruit districts of California, Oregon and Washington where it was formerly believed that irrigation was not necessary.

The conditions desirable for fruit growing are that the growing season be sufficiently long to mature the fruits and that there be no great or sudden fluctuations between high and low temperatures in the winter and spring time. At very high elevations the growing season is too short.

Early frosts in the fall and sudden increases of temperature in the spring, followed by severe late spring frost, may cause considerable damage.

Strong winds are destructive to both trees and fruit and should be provided against by planting wind breaks. The existence of strong winds may be indicated by the trees being permanently bent.

2.—Chemical Composition of the Soil.

The soil must contain all chemical plant food elements and decayed organic matter or humus. As a rule if the soil is deep, these are all present in sufficient quantity with the exception of humus which is often lacking. The lack of organic matter can, however, be corrected by growing suitable crops.

The soil and subsoil should be free from alkali salts. This may be indicated by the character of the native plants. Sagebrush and buffalo grass usually indicate that the soil is easily cultivated, well drained, deep, free from alkali and fertile in chemical plant food, but some times deficient in humus. Greasewood and salt grass indicate the presence of alkali. An analysis of the soil will be of great value. The soil should be rich in potash, phosphoric acid, nitrogen, lime and humus.

3.—Texture of Soil and Subsoil.

The best soil is one which is deep, retentive of moisture and underlaid with an open subsoil. The presence of a hard or impervious stratum closer than 5 feet to the surface is injurious and a greater depth is preferable. The hard stratum prevents deep rooting which is essential for fruit trees. A shallow soil underlaid with open gravel may not have sufficient plant food, will require frequent irrigations, and may cause a large waste of water. Fruit trees will grow in a variety of soil. Apples prefer a deep, retentive loam rich in humus. Cherries will probably do best on a well drained, sandy soil or light clay loam, rich in plant foods, but it should not contain an excess of nitrogen, which has a tendency to produce excessive wood growth. Peach trees will do best on sandy soil. Pears will grow best on clay soils and can be grown on the heavier bottom lands. They all require a deep, rich, well drained soil.

The character of the soil and subsoil is best determined by boring holes with a soil auger to a depth of 10 feet.

The behavior of the soil when irrigated is important. A clay soil or soil which is very close will absorb water very slowly and is more difficult to cultivate and will probably bake after each irrigation. As a rule a sandy loam irrigates well and is easy to cultivate but a very porous soil will allow the water to percolate freely beyond the reach of the plant roots without spreading sideways when applied in furrows.

4.—Location and Site of Orchard.

The orchard must have good air drainage as well as soil drainage. The best air drainage is obtained on rolling lands, on hillsides or on the benches well above the bottoms or lower sides of ravines or depressions where the cold air settles at night. A very desirable location is found at the upper end of small valleys. What is desired is the daily occurrence of good air currents.

There seems to be considerable difference of opinion as regards proper exposure. A southern exposure will usually produce earlier fruit because of the earlier growth in the spring, but where there is danger of injury because of late spring frosts a northern exposure will retard the budding and there is less liability of the trees being injured.

5.—Surface Conditions.

The best land for irrigation must have a uniform slope and be free from ravines or depressions which increase the cost of the distribution system and which are liable to be damaged by the accumulation of waste water. Irregular slopes are difficult to irrigate. Land which is smooth is much cheaper to prepare for irrigation. Slopes which are very steep can often be well irrigated by running the furrows across the slopes. Very few soils can be irrigated without excessive washing of the soil on slopes steeper than 10 feet in 100 and usually the fall of furrows should be less than 2 feet in 100. The washing of the soil and in some cases the leaching out of the fertilizing salts from the upper part of the orchard may not be noticeable at first, but the accumulation of this effect may do considerable injury to the land. Steep slopes also have the disadvantage that they make cultivation, spraying and handling the fruit more difficult.

6.—Drainage.

The drainage of the soil is very important. The intending purchaser who wishes to grow an orchard or other deep rooted plants should avoid low lying lands. On a tract which is under a new irrigation system the bottom land may be quite dry and the water table far below the surface. The soil may be quite porous and underlaid with gravel. This may lead to the belief that drainage conditions are very good. But with the extension of irrigation on the higher surrounding land, the drainage conditions are often changed. The higher land is usually porous, absorbs water readily and encourages a waste of water which is not always avoidable. This effect, combined with the percolation losses from leaky ditches will cause a gradual rise of the water table, and unless there is a good natural drain in the trough of the valley, the water table will soon rise until it is near the surface and finally drown out the trees or plants.

Land where the water table has not yet reached the danger height is sometimes spoken of as sub-irrigated land and many advantages are claimed for it, but as a rule this land will soon be injured by a continued rise in the water table and should be avoided for deep rooted plants at least.

While the higher lands are usually free from injury by water logging, there are many instances where layers of hardpan may collect the water and interfere with its downward percolation and cause a rise of the water table too near the surface.

The purchaser should investigate these conditions thoroughly and examine the subsoil as well as the top soil by boring deeply with an auger.

PREPARATION OF LAND FOR ORCHARD.

1.—Clearing the Surface.

Land to be irrigated is seldom heavily timbered and is generally free from timber. To prepare land which is timbered the first operation is the felling of the trees which are used for lumber or cut into firewood, the value of which may partly pay for the cost of clearing. The removal of the stumps is the next operation. This may be done by various methods, but the process is always quite expensive. It may be done: First, By the hand method with shovels, picks, mattocks and axes. Second, By the use of stump pullers. Third, By the use of powder. Fourth, By the burning method, which consists of boring auger holes at the foot of the stump into which fires are built. Sixth, By the char pit method. This last method which has been developed recently, has given very good results. The cost

of removing stumps in the State of Washington by this method was found to vary from 25 cents to \$1.00 each for stumps as large as 40 inches in diameter. While the method is most economical for clay soil, it was found that it could be successfully applied to sandy soil. The method has been fully described in General Bulletin 101 of the Agricultural Experiment Station of Washington State College at Pullman, Washington. The cost of clearing will naturally vary with the density of growth and the method used to remove the stumps. It may vary from a few dollars to fifty or one hundred dollars for heavily timbered land.

Where the native vegetation is small brush or grasses, the land should be plowed deeply, then raked to remove the large brush, which is burned. This is followed by harrowing and the grading operation.

Where the vegetation is tall sagebrush, it must be removed before the land can be plowed. This may be done in several ways. Where the brush is not abundant it may be grubbed off by hand. Where the brush is thick and very dry it may be burned off while standing. A method largely used in the Yakima Valley is to break off the brush by drawing a railroad rail or heavy timber over the land, first in one direction and then in the other. The best time to do this is when the ground is frozen. It requires a team on each end of the rail. The brush breaks off at or below the surface and is then raked into windrows or piles and burned.

The cost of clearing off heavy brush in the Yakima Valley varies from about \$2.50 to \$3.00 per acre when done with a rail and teams and about \$3.75 when done by hand. The cost of the first plowing is about \$1.50 to \$2.00 per acre. The plowing is followed by harrowing and then the surface is ready to be graded and prepared for irrigation. This includes the proper location of the ditches, the grading of the land and in some cases the growing of some crop to improve the condition of the soil.

Before grading the surface the location of head ditches or flumes must be decided on. They must be so placed that when constructed they will give the furrows a desirable grade and must divide the field so that the furrows will not be over 300 feet long for sandy soil and 500 to 600 feet for more impervious soil. Before the construction of these ditches the land must be graded to conform with them.

The grading of the land has been usually neglected in the irrigated sections of British Columbia. This is due largely to the character of the land. Much of it is rolling or on fairly steep hillsides which can be irrigated without grading. But in many cases the land would have been much improved by some grading.

The mistake is often made of planting orchards and other crops before the land has been even properly cleared in order to give the trees an early start and shorten the time before they will bear. In some cases this results in leaving a field or orchard which is difficult to irrigate and which can not be improved by grading because of the trees or other crop which have been planted. The time gained by planting earlier will often be more than balanced by the poor growth due to improper condition of the soil and the uneven application of water. The loss in time necessary to apply the water on poorly prepared land and the waste of water is often greater than the cost of preparing the land.

For furrow irrigation, which is the method most universally adaptable to British Columbia, the only grading necessary is that the land be given a uniform slope and all irregularities removed by scraping off the humps

and filling the depressions where otherwise water would collect. Rolling land or land having a steep slope usually requires little grading.

The implements needed for grading are usually some form of scraper and a smoother or leveler. For removing large knolls or for carrying considerable earth the Fresno scraper, which is a wide steel scraper, is extensively used. For loose sandy soil and where the haul is short, the Buck scraper is very effective. It is used extensively in the Yakima Valley and in nearly all irrigated districts. It consists of a board 10 to 14 feet wide, shod along one edge with a steel plate, which can be adjusted to any angle by means of a lever arrangement connected to it and to a foot board or tail board (Fig. 1). To finish the surface smooth a leveler sometimes called float or drag is used after the scraper (Fig. 2).

Fig. 1.—Buck scraper for leveling land.
(Farmers' Bulletin 373, U. S. Dept. Agr.)

Fig. 2.—Leveler or float.
(Farmers' Bulletin 392, U. S. Dept. Agr.)

2.—Growing Crops to Improve Condition of Soil.

Most soils of the arid type are lacking in organic matter or humus and can be much improved by preliminary cropping to plants which will add humus and bring the soil into good condition. The crops used are clover, alfalfa, peas or cereals. Prof. Fisher, horticulturist for the Montana Agricultural College, states that a method which is practiced with success is to plow the land deep in the fall and grade it. In the spring following oats and red clover are planted. The oats are harvested the following fall and the next year one crop of clover hay can be cut and the second crop plowed under as a green manure. Prof. Judson, horticulturist for the University of Idaho, recommends clover the first season, plowed under in the fall, and potatoes or other hoed crop planted the following spring.

3.—Locating the Tree Rows.

The tree rows should be located to facilitate the application of water. On steep slopes it is desirable to run the furrows on a grade not steeper than 2 feet in 100. It is therefore advantageous to locate the tree rows on a line which will give about this grade. There are two common methods of laying out orchard tracts, one known as the square method and the other as the hexagonal or the equilateral triangle system. The square system is easier to lay out and is best adapted to the use of fillers. The hexagonal system has the advantage that the furrows can be run in three or four different ways and that the trees cover the ground more uniformly. The two methods are illustrated in the accompanying sketches. The square system shows an apple orchard with fillers. These sketches are taken from Farmers' Bulletin 404, (U. S. Dept. Agr.) which gives the following information:

"Under irrigation systems peach trees should be spaced 20 to 22 feet, pear and cherry trees 22 to 28 and 30 feet, apple trees 30 to 36 feet. On the Pacific Coast the tendency toward wide spacing has induced many growers to insert peach fillers between the slower growing apple trees. The arrangement of trees in a young orchard in Douglas County, Washington, is shown in the square system shown above. Here the trees are set in squares 18 feet each way but in every other row peach trees alternate with the standard apple trees. In the remaining rows Winesap apple trees are used for fillers. As the apple trees grow and begin to crowd the fillers, the peach trees are removed. If more space is required the Winesaps can be taken out leaving the apple trees in squares 36 feet both ways."

Fig. 3.—Plan of planting apple orchard with fillers.

Fig. 4.—Hexagonal or triangular plan of planting orchard.

The methods of staking out the orchards to locate the position of the trees and the setting of the trees as well as other information on apple growing are given in Bulletin No. 43 on Planting the Apple Orchard, published by Agricultural Experiment Station at Moscow, Idaho, also in Bulletin 77 on Fruit Tree Planting in Montana, published by Montana Agricultural College Experiment Station at Bozeman, Montana.

II.—UNITS OF MEASUREMENT OF WATER AND METHODS OF MEASURING WATER.

NECESSITY FOR KNOWLEDGE OF MEASUREMENT OF WATER.

When water is so plentiful that the irrigators can obtain all the water they want and whenever they want it, there is no trouble about its division and no necessity is felt for the measurement of water. But these conditions do not prevail in many districts and where they do exist a knowledge of the measurement of water will help to prevent the large waste due to crude methods of irrigation and to over-irrigation which may damage not only the crops of the careless irrigator but also the land and crops of the landowners below, by the waterlogging of the soil.

Where water is not so abundant the necessity for a knowledge of the measurement of water is felt to a greater extent. An equitable division of the water can only be obtained by correct measurements. The orchardist or irrigator can only know whether he is getting the water he is entitled to or not by measurements of the water delivered. It is only by such means and from a knowledge of the values of the units of flow that the depth of water applied to the land is obtained. This is desirable if the orchardist wishes to irrigate intelligently and determine the effects of different quantities of water on the amount of crops produced.

Other reasons for which there is a necessity for a knowledge of the measurement of water are:

First.—To measure the amount of water carried in a creek or the discharge of a pump.

Second.—To know the required capacity of a pump or of a ditch to give a certain volume of water on a given area of land.

Third.—To determine by measurements at different points on the ditch the seepage losses occurring in that section of ditch.

Fourth.—To be able to compute the storage capacity of a reservoir necessary to give a flow to irrigate a given tract of land.

UNITS OF MEASUREMENT.

The units of measurement can be divided into two classes: first, those used for flowing water; second, those used for water at rest. The units commonly used for flowing water are the cubic foot per second and miners' inch, and for water at rest, the acre foot is used.

1.—The Cubic Foot Per Second or Second Foot.

The cubic foot per second is the standard unit of measurement of flowing water in British Columbia. It may be defined as a cubic foot of water moving at the rate of one lineal foot each second. For instance, a flume 12 inches wide, carrying a depth of water of 12 inches, and placed on such a grade as to give a velocity to the water of 1 lineal foot each second has

a carrying capacity of 1 cubic foot per second. In any case the cross sectional area in square feet multiplied by the velocity in feet per second will give the discharge in cubic feet per second.

2.—The British Columbia Miners' Inch.

The legal value of the miners' inch in the Province of British Columbia is the quantity of water that will pass through an orifice two inches high by half an inch wide made in a two inch plank, the water to have a constant head of seven inches above the upper side of the orifice, and every additional inch of water shall mean so much as will pass through the said orifice extended horizontally half an inch.

In cubic measurement one inch of water shall mean a flow of water equal to 1.68 cubic feet per minute. This is equivalent to 35.7 miners' inches for one cubic foot per second.

3.—Acre Foot.

This unit of measurement is the best unit for measurement of large volumes of water at rest and is the legal unit in British Columbia (Water Act 1909). It may be defined as the quantity of water which will cover one acre to the depth of one foot; it is equal to 43,560 cubic feet.

An acre inch is equivalent to 1-12 of an acre foot. It is equal to the quantity of water which will cover one acre one inch deep.

4.—Relation Between Cubic Foot Per Second, Miners' Inch and Acre Foot.

The cubic foot per second and the miners' inch indicate only a rate of flow and to specify any fixed quantity it is necessary to state the time or duration of flow. For instance a flow of 1 cubic foot per second will give in one 24 hour day as many cubic feet as there are seconds in that time or 86,400 cubic feet which is equal to nearly 2 acre feet or 24 acre inches. In other words a flow of 1 cubic foot per second in one hour will give a quantity of water sufficient to cover one acre to a depth of one inch.

The miners' inch as defined by the Water Clauses Consolidation Act, 1897, is equal to about 1-36 of a cubic foot per second, or one miners' inch in thirty-six hours will give as much as one cubic foot per second in a period of one hour, which quantity is about 1 acre inch. As a unit of measurement the miners' inch is condemned by many engineers. While there are some objections there are also many advantages in its use. The objections usually raised are:

First.—That its value in British Columbia and in the different western states of the United States is not uniform.

Second.—That the unit is associated with a measuring device and unless the factors controlling the method of measurement are correctly prescribed by law and followed in making the measurement, it is liable to give inaccurate results. The Consolidation Act of 1897 requires that it be measured through a board 2 inches thick. This, as explained farther, is objectionable and greater accuracy would be obtained by using a thin board not over 1 inch thick.

Third.—The term has often been confused with the cross sectional area in square inches of a flume or pipe. For instance if a flume is 10 inches wide and 6 inches deep: it is sometimes wrongly stated by some irrigators that there are 60 miners' inches, the irrigator not thinking that the flow is also dependent on the velocity of the water which varies with the grade of the flume.

The main advantage of this unit of flow is that for small flows the irrigator has a better understanding of its volume when stated in miners'

inches. However, as a method of measurement, it has some advantages as explained farther.

To convert measurement from one unit into another the following equivalents are useful:

1 cubic foot per second is equal to 35.7 miners' inches.

1 cubic foot per second is equal to 6.25 Imp. gallons per second, or 7.5 U. S. gallons per second.

1 cubic foot per second will give in one minute, 375 Imp. gallons, or 450 U. S. gallons.

1 cubic foot per second will give in 24 hours, 2 acre feet (approximately), or 1 acre inch in one hour.

1 British Columbia miners' inch will give in one minute, 10.5 Imp. gallons, or 12. U. S. gallons.

1 British Columbia miners' inch running for 36 hours will give 1 acre inch.

METHODS OF MEASUREMENTS.

Measurements of water may be obtained by means of:

1. Volumetric measurements.
2. Weirs.
3. Miners' inch boards or boxes.
4. Special devices such as Grant-Michell meter.
5. Measurements of velocity of water and cross section of canal or flume.

For a measuring device to be entirely satisfactory it should meet the following requirements:

1st. It should not only measure the water at any one time, but it should keep a continuous record of all water delivered.

2nd. In many cases it is desirable that it should maintain a constant flow when once it is set for full capacity or fraction of full capacity.

3rd. It should be able to handle any fraction of its full capacity.

4th. It should not require difficult computations to obtain the results of the measurements.

5th. It should not be easily interfered or tampered with.

6th. Where the available grade is small it should require the least possible loss of head.

7th. The cost of the device should not be excessive.

There is no device which will fulfill all these requirements.

On the irrigated systems of British Columbia the heads of water delivered to the irrigators are usually small, in many cases only a few miners' inches, and there is generally sufficient fall or grade to permit the installation of any type of measuring device. The devices which are most feasible at a moderate cost for delivery of water to the irrigator are the weir box and the miners' inch box.

To measure the flow of streams or canals the weir board may be used when there is sufficient fall to allow its installation; otherwise measurements of the cross section and of the velocity by means of floats or current meters must be made.

1.—Volumetric Measurements.

This method of measurement can only be used for very small volumes of water. It consists of a tank of a given volume in which the irrigating

water is delivered, and the time to fill the tank is recorded. Knowing the volume in cubic feet and the time in seconds, the rate of flow in cubic feet per second may be obtained by dividing the first by the other. For instance, if the tank is 2 feet wide, 4 feet long, and 2 feet deep, it holds 8 cubic feet of water and if it takes 40 seconds to fill the box the rate of flow is 8 cubic feet in 40 seconds or 1-5' of a cubic foot per second or about 7 miners' inches.

2.—Weirs.

The weir is the most generally used measuring device found on irrigation systems, for the reason that it is simple to construct and use and will give accurate results when properly installed. The weir is generally limited to moderate quantities of water and requires sufficient fall or grade for its installation and for these reasons can not always be used, but in British Columbia the quantities of water to be measured are usually small and in most cases there is ample fall. These conditions are very favorable for the installation of a weir.

The term weir is applied to any dam or barrier across the stream over which the water flows. The weirs used in irrigation consist of a board or barrier into which a notch is formed through which the water flows. The volume of water passing through the notch is obtained by knowing the length of the notch and measuring the depth of water passing over it. The form of notch is generally either trapezoidal or rectangular and in some cases a triangular or V shaped notch is used.

The trapezoidal weir is known as the Cippoletti weir and is more common than the other forms. It consists of a horizontal crest and the two sides, each sloping outward one inch for every four inches rise. The rectangular weir has vertical sides. The first form has the advantage that the flow may be computed by means of a simpler formula. The second form is a little easier to construct and is more accurate because its formula has been derived from a larger number of experiments. In either case the flow can be obtained by referring to the tables given farther.

The weir may consist of a simple board placed across the ditch or of a board set in a short section of flume or box, in which case it is called a weir box. The weir board may be of wood, metal or concrete. When made of wood or concrete it is desirable to use a metal plate to form the edges of the crest and the sides. When no weir box or flume section is used, the weir board is placed directly across the canal, and sufficiently braced with posts. A weir box or flume box is generally used. The box is a short flume section whose length is not less than 8 to 12 feet. The width and depth must be at least sufficient to give the required dimensions to the weir board. The weir board should be placed at a distance from the upstream end equal to two-thirds the length of the box, the lower third forming a floor for the falling water. The depth measurement should be made at least 4 to 6 feet upstream from the crest, from a post or scale fixed on the side of the flume with the zero point level with the weir crest. To obtain accurate results the following rules for the dimensions of the notch should be observed:

1st. The greatest depth of water which should be allowed on the crest of the weir should not be more than one-third the length of the weir and the least depth 1 inch. The depth is usually controlled by the fall avail-

able. Where the fall available is small, a large length and small depth are necessary.

2nd. The distance from the crest of the weir to the bottom of the canal or floor of the weir box should be at least three times the depth on the weir.

3rd. The distance from the edges of the weir notch to the sides of the canal or of the weir box should be at least twice the depth on the weir.

4th. The upstream side of both the crest and the edges of the weir notch should be brought to a knife edge or to a sharp corner; the bevelling should be on the downstream side. With a sharp corner and a thickness of crest not greater than one-half the minimum depth of water the discharge will be the same as for a knife edge.

In placing the weir in position the following directions must be followed:

1st. The weir when used on a ditch should be placed in a section of the ditch which is straight for at least 50 feet above the weir and the center line of the ditch should be perpendicular to the weir board and pass through its center. The cross section of the channel should be not smaller than the cross section of the weir box, in order to have slow velocity and fairly calm water above the weir. If the weir box must be placed near the takeout gate the velocity must be made uniform by means of baffles.

2nd. The weir must be set high enough to give to the overflowing sheet a free fall on the downstream side. A common rule is to make the level of the water on the downstream side lower than the crest by not less than one-half the depth of water on the crest. To obtain the free fall it is best to select a section of the ditch which has considerable grade.

3rd. In letting water in a weir box through a pipe it should discharge at the bottom of the box and the depth of the box should be sufficient to produce a calm body of water on the upstream side of the weir. In some cases this requires the use of baffle boards to break up the velocity of the approaching water.

4th. The crest of the weir should be level from end to end.

5th. The measurement of head should show the true elevation of the water surface above the weir crest. Directly at the crest and for a short distance above it the water surface curves down. This requires that the water be measured a certain distance upstream.

Measurement of discharge.

When the weir has been installed the only measurement to take is the depth of water or head over the crest of the weir. To make this measurement it is necessary to provide a reference point level with the weir crest, from which the depth is measured. This point must be at least 2 feet upstream from the weir crest for a small weir, and preferably 4 to 6 feet. For a weir box this reference point may be a nail driven part way in the side of the box at the level of the weir crest, or a bracket or support formed by nailing a strip to the side of the box. For a simple weir board a stake may be driven into the ditch. The depth of water above the reference point can be obtained sufficiently close for ordinary purposes by using a carpenter's rule and reading the depth to nearest one-eighth of an inch.

Knowing the length of the weir crest and having obtained the depth of water, the discharge in cubic feet per second or miners' inches may be obtained by referring to the following tables:

Table of Discharge for a One Foot Cippolletti Weir.

Depth of water on crest.			Depth of water on crest.		
Discharge.			Discharge.		
Inches.	Cubic feet per second.	Miners' inches.	Inches.	Cubic feet per second.	Miners' inches.
1	.08	2.9	4	.65	23.1
1 $\frac{1}{8}$	.10	3.5	4 $\frac{1}{8}$	.68	24.2
1 $\frac{1}{4}$	.11	4.0	4 $\frac{1}{4}$	.71	25.3
1 $\frac{3}{8}$	.13	4.6	4 $\frac{3}{8}$	.74	26.5
1 $\frac{1}{2}$	.15	5.4	4 $\frac{1}{2}$	.77	27.6
1 $\frac{5}{8}$	.17	6.1	4 $\frac{5}{8}$	.81	28.8
1 $\frac{3}{4}$	.19	6.8	4 $\frac{3}{4}$	.84	29.9
1 $\frac{7}{8}$	.21	7.5	4 $\frac{7}{8}$	.87	31.1
2	.23	8.2	5	.91	32.3
2 $\frac{1}{8}$	.25	9.0	5 $\frac{1}{8}$	.94	33.5
2 $\frac{1}{4}$	.27	9.6	5 $\frac{1}{4}$	.97	34.7
2 $\frac{3}{8}$	.30	10.5	5 $\frac{3}{8}$	1.01	36.0
2 $\frac{1}{2}$	.32	11.4	5 $\frac{1}{2}$	1.04	37.0
2 $\frac{5}{8}$	.34	12.3	5 $\frac{5}{8}$	1.08	38.5
2 $\frac{3}{4}$	.37	13.2	5 $\frac{3}{4}$	1.12	40.0
2 $\frac{7}{8}$	.40	14.1	6	1.19	42.5
3	.42	15.0	6 $\frac{1}{4}$	1.26	45.0
3 $\frac{1}{8}$	.45	16.0	6 $\frac{1}{2}$	1.34	48.0
3 $\frac{1}{4}$	.47	17.0	6 $\frac{3}{4}$	1.42	51.0
3 $\frac{3}{8}$	.50	18.0	7	1.50	53.5
3 $\frac{1}{2}$	.53	19.0	7 $\frac{1}{4}$	1.58	56.0
3 $\frac{5}{8}$	.56	20.0	7 $\frac{1}{2}$	1.66	59.0
3 $\frac{3}{4}$	.59	21.0	7 $\frac{3}{4}$	1.75	62.5
3 $\frac{7}{8}$	.62	22.0	8	1.83	65.0

This table is computed for a one foot Cippolletti or trapezoidal weir, but it may be used for longer weirs by multiplying the quantities given by the length of the weir in feet. For instance a two foot weir will give twice the discharge obtained for a one foot weir. An 18 weir will give $1\frac{1}{2}$ times the values given in the table. For accuracy a one foot weir should not be used for depths greater than about 4 inches. For larger discharges it is preferable to use a longer weir crest.

Table of Discharge for Rectangular Weirs With Full Contractions.

Depth of water on crest. Inches.	Discharge for one foot weir.		Discharge for two foot weir.		Discharge for three foot weir.	
	Cubic feet per second.	Miners' inches.	Cubic feet per second.	Miners' inches.	Cubic feet per second.	Miners' inches.
1	.079	2.8	.159	5.7	.239	8.5
1 1/8	.094	3.3	.189	6.75	.285	10.2
1 1/4	.110	3.9	.222	7.9	.33	12.0
1 3/8	.126	4.5	.255	9.1	.38	13.75
1 1/2	.144	5.1	.29	10.4	.44	15.6
1 5/8	.161	5.8	.32	11.7	.49	17.6
1 3/4	.180	6.4	.36	13.0	.55	19.7
1 7/8	.20	7.1	.40	14.5	.61	21.8
2	.22	7.8	.45	16.0	.67	24.0
2 1/8	.24	8.6	.49	17.5	.74	26.3
2 1/4	.26	9.3	.53	19.0	.80	28.7
2 3/8	.28	10.1	.58	20.5	.87	31.0
2 1/2	.30	10.8	.62	22.1	.94	33.5
2 5/8	.32	11.6	.67	23.8	1.01	36.0
2 3/4	.35	12.5	.72	25.5	1.08	38.5
2 7/8	.37	13.3	.76	27.2	1.16	41.2
3	.40	14.1	.81	29.0	1.23	44
3 1/4	.44	15.8	.91	32.6	1.39	50
3 1/2	.49	17.6	1.02	36.4	1.54	55
3 3/4	.54	19.5	1.13	40.2	1.71	61
4	.60	21.3	1.24	44.1	1.88	67
4 1/4	.65	23.3	1.36	48.4	2.06	73
4 1/2	.71	25.2	1.47	52.6	2.24	80
4 3/4	.76	27.3	1.49	57.0	2.43	87
5	.82	29.4	1.72	61.4	2.61	93
5 1/4	.86	31	1.84	66	2.81	100
5 1/2	.94	33	1.97	70	3.00	107
5 3/4	1.00	36	2.11	75	3.20	114
6	1.06	38	2.23	80	3.41	122
6 1/4			2.38	85	3.63	130
6 1/2			2.51	90	3.87	138
6 3/4			2.65	95	4.06	145
7			2.80	100	4.29	153
7 1/2			3.00	107	4.47	160
8			3.40	121	5.20	186
8 1/2			3.70	131	5.65	201
9			4.00	142	6.15	220
9 1/2			4.30	154	6.64	237
10			4.64	166	7.15	255
10 1/2			5.00	178	7.71	275
11			5.32	190	8.24	295
11 1/2			5.65	202	8.78	314
12			6.00	215	9.34	333

The above table is for rectangular weirs with crest 1 foot, 2 feet, and 3 feet long. It will be noticed that for this type of weir the discharge is not exactly in proportion to the length of the weir crest, especially for the greater depths of water on the crest.

The form of construction of the weir will depend on the conditions where it is used. It may be used on a ditch or a flume in which case it is placed either as a weir board or a weir box across the canal or flume as shown in the accompanying illustrations (Fig. 5, 6, 7, 8, 9) or it may be used to measure the water taken out of a pipe in which case it is placed around the takeout valve as shown in Fig 11.

Fig.5.—Trapezoidal weir board placed across a ditch.
 (Courtesy of Irrigation Investigations Office, U. S. Dept. of Agr.)

Fig. 6.—Trapezoidal weir board with side wings and apron.
 (Courtesy of Irrigation Investigations Office, U. S. Dept. of Agr.)

Fig. 8.—Rectangular weir box.
(Courtesy of Irrigation Investigations Office, U. S. Dept. of Agr.)

Fig. 9.—Rectangular weir in concrete lined canal.
(Courtesy of Irrigation Investigations Office, U. S. Dept. of Agr.)

Fig. 12.—Weir box take out valve.

Fig. 13.—Weir box in position.

Fig. 14.—Weir box and take out from pressure pipe used by Gage Canal Co., Riverside, Cal
(O. E. S. Bulletin 119, U. S. Dept. Agr.)

Fig. 11.—Typical weir box for valve take out from pressure pipe line.

Weir box and takeout from pipe line under pressure.

Where the water is carried in a pipe line under pressure the water must be delivered through a valve connected to the pipe. A good type of measuring weir box will consist of a rectangular box placed around the valve, with the measuring board placed at the top of one side of the box. Fig. 11 shows a form of measuring box very similar to those installed on the cement pipe lines of the irrigation system of the Fruitlands Irrigation and Power Company near Kamloops. It consists of a concrete measuring box placed around a takeout valve cemented to the pipe line. The valve is obtained from the Kellar and Thompson Manufacturing Company of Los Angeles. It is cemented over a hole cut in the cement pipe and regulates the flow in the box. The box is rectangular, made of four concrete walls 4 inches thick, reinforced with strands of barb wire 6 inches apart. A notch is formed in one of the side walls and a rectangular weir plate made of galvanized iron strips is cemented in. To measure the depth of water above the crest a metal bracket is cemented in the wall opposite the weir opening and at the same level as the weir crest. The water which passes over the crest discharges into the irrigator's flume or ditch. In case of an earthen ditch it is necessary to prevent erosion or washing away of the soil by the falling water by providing a receiving box or basin or by protecting the soil with paving.

Similar boxes are used in southern California for delivering water from cement pipes and iron pipes, and could well be used in British Columbia for delivery from wooden pipes into the private flumes or ditches.

Figs. 12, 13, 14 show the type of box used by the Gage Canal Company of Riverside, California. The box is not built in place but is cast in wooden forms. It consists of a floor slab and a tapering rectangular box. Fig. 14 shows the box in position connected to a private concrete flume. The inside of the box is 45 inches deep, 16 inches square at the top and 22 inches square at the bottom. The walls and floor slab are 2 inches thick. The opening for the weir is 12 inches high and 14 inches wide and the metal weir plate which is cemented in this opening gives a rectangular notch 10 inches wide and 8 inches deep.

Some irrigation companies in southern California simplify the construction of the weir boxes by using in place of the rectangular box, two or more sections of large size cement pipe placed vertically around the valve. The weir is formed by cementing a weir plate in a notch cut in the upper part of the pipe.

3.—Miners' Inch Board or Box.

The miners' inch as a unit of measurement has the disadvantages previously stated but the method of measurement associated with the miners' inch unit has many advantages.

1st. The irrigator can tell at a glance how much water is being delivered. It requires no computation or reference to tables.

2nd. It is well adapted to measuring small volumes of water and is fairly accurate if properly carried out.

3rd. The flow through a miners' inch board is affected much less by a change in water level than the flow over weir. A 10 per cent. rise of water level will increase the flow over a weir by 15 per cent. while with a miners' inch board the flow is increased only 5 per cent.

The disadvantages are:

1st. The device is not adaptable to large volumes of water because the required length of the orifice may be too great.

2nd. Unless the conditions necessary for accurate measurements are carried out, the results obtained may be very inaccurate.

The device consists of a board or thin wall in which is made an orifice, which conforms with the conditions necessary to give the volume as defined by law. The board may be set directly across the ditch or it may be placed in a short section of flume or in a box.

The controlling conditions to give measurements in British Columbia miners' inches are given in the Water Clauses Consolidation Act of 1897. Briefly stated the miners' inch orifice must be 2 inches high and the head on the upper side of the orifice must be 7 inches; this gives 8 inches on the center of the orifice. The Act states that the orifices must be made in a 2 inch board. This thickness is liable to give inaccurate results, unless the four edges of the orifice are bevelled outwards so as to give sharp corners. To obtain accurate results the jet coming through the orifice must touch only the upstream edges and clear the downstream edges so as to discharge freely into the air. With a board 1 inch thick, if the corners are sharp, it is not necessary to bevel the edges for the water jet will clear the outer edges. It is, however, preferable to either bevel the edges or use thin metal plates. The orifice must be made of such length that it will measure the maximum amount of water desired. For instance if this volume of water is 100 miners' inches, the orifice 2 inches high must be 50 inches long. To obtain a smaller volume the orifice must be adjustable by means of a sliding gate.

To measure a large volume of water the length of the orifice will be excessive. To avoid this it may be desirable to use an orifice 4 inches high instead of 2 inches. This will make the necessary length only one-half the length required for the 2 inch height and the accuracy of the device will not be affected to any great extent provided the orifice is made in a thin plate. In either case the head on the center of the orifice must be 8 inches.

To obtain accurate results at least 6 inches must be allowed on the upstream side of the board from the lower edge of the orifice to the bottom of the ditch or floor of the box into which the board is placed, and at least 2 to 4 inches from the ends of the orifice to the sides of the ditch or box. On the downstream side the jet should discharge freely into the air.

The form of construction of the miners' inch measuring device will depend on the purpose for which it is used. It may be used to measure the flow in a ditch or flume in which case it may be given the form shown in Fig. 15 or it may be used to measure the water carried by a pipe under no pressure and is then built as shown in Fig. 16. Where the pipe is under pressure the miners' inch box can be built around the valve in the same manner as the weir box shown in Fig. 11, using a miners' inch orifice plate in the place of the weir plate.

Miners' inch box placed in canal or ditch.

The form of miners' inch box to use for measurement of water carried by a flume or ditch is shown in Fig. 15. This box consists of a short section of flume with the miners' inch board placed at the downstream end. The box may be made as the weir box shown in Fig. 7 and connected with the earth ditch by similar wings and cut off apron. The miners' inch ori-

fice is 2 inches high and its length adjustable by a slide. The center of the orifice is 8 inches from the top of the board, the lower edge of the orifice is 6 inches above the floor. The edges of the orifice are bevelled on the downstream side. The slide consists of a 1 in. x 6 in. piece which passes through a hole of the same size cut through the side of the box. At one end of this piece is screwed a short block which fits into the bevelled orifice and which has one edge bevelled to conform with the other edges of the orifice. To measure the water the slide is pushed in or pulled out until the water stands level with the top of the board; when the slide is pushed in too far the water overflows the top of the board; when the orifice is opened too wide, the water level drops below the top. The number of miners' inches passing through is equal to the length of the orifice multiplied by two. To facilitate the measurements the orifice may be graduated with inch and quarter inch marks, each half inch representing a flow of 1 miners' inch.

Fig. 15.—Miners' inch measuring box.

TYPICAL MINERS INCH BOX FOR TAKE OUT
FROM GRAVITY PIPE LINE UNDER NO PRESSURE.

Fig. 16.

Miners' inch box and takeout from pipe line under no pressure.

Where a pipe line is under no pressure the conditions of flow are similar to those in an open ditch. The pipe line is placed on grade and to take out water from it, it is necessary to form a takeout box by means of which the water is checked and forced to rise to the height at which it is delivered to the irrigator. This is somewhat similar to the check gates which are placed across an open canal where it is necessary to raise the water level to make a delivery into the head of the irrigator's flume or ditch. For a pipe line the takeout and measuring device can be formed in one structure as shown in Fig. 16. This form of box is used on the Fruitlands Irrigation system near Kamloops and is similar to the boxes used on many irrigation systems of southern California. The box is rectangular and is divided into two compartments by an overflow wall at the bottom of which there is an opening, controlled by a slidegate. In one of the side walls of the upstream compartment a miners' inch plate is placed with the center of the orifice 8 inches below the crest of the overflow wall. The walls are all reinforced with strands of barb wire. The water enters the upstream compartment

and by means of the gate in the overflow wall can be made to rise level with the overflow crest and the quantity delivered is regulated by adjusting the orifice. The pressure on the orifice is regulated and kept more or less constant by the overflow wall. The excess water passes over the overflow wall and also through the regulating gate into the downstream compartment and from there into the pipe. By proper adjustment of the gate the water level may be kept fairly constant. When the gate is entirely closed the excess water will pass over the overflow and increase the pressure on the orifice and the accuracy of the measurement will depend on the quantity of water passing over and the length of the overflow crest. A moderate increase in pressure will not affect the accuracy very greatly, for instance a 1-inch increase in pressure will increase the volume delivered by 6 per cent. It would be feasible to use a weir plate in place of the miners' inch plate, but with a weir plate the quantity delivered could not be adjusted and the accuracy would be affected to a much greater extent by an increase in depth of water on the crest.

Fig. 18 shows a similar box used in southern California. It differs from the previous one in that instead of delivering the water through an orifice adjustable in size by a slide, it is delivered through a number of openings varying in size and each closed by a slide gate. In the illustration the three smaller orifices are opened and the fourth one closed. The water passes through the orifices into a basin formed by two half sections of pipe cemented to the box and connected at the bottom to the private pipe of the orchardist.

Miners' inch box and takeout from pressure pipe line.

To deliver water from a pipe under pressure and measure it by miners' inches the same form of construction could be used as for a weir box (Fig. 11), using a miners' inch plate instead of the weir plate. This form of miners' inch box is shown in Fig. 19 which illustrates a box used in southern California. In this case the orifice is 5 inches high and is regulated by two slides. The pressure on the center of the orifice is 4 inches, which gives a depth of water of only $1\frac{1}{2}$ inches from the upper edge of the orifice to the water level. The height of the orifice is too great in proportion to the pressure.

Miners' inch box with overflow wall for canals or flumes.

The use of an overflow to regulate the head on the opening can be applied to miners' inch boxes installed in earth ditches or in flumes very much in the same manner as for pipe lines. Fig. 20 illustrates the construction of the device. It consists of a section of flume divided into two compartments by the parallel overflow crest wall in between. The compartment which forms part of the supply ditch is open at both ends and the flow can be checked or regulated by flashboards. The other compartment forms the box from which the water is taken out through the orifice in the side wall. The flow into the box is regulated by a gate and the excess passes over the crest of the overflow wall back into the canal. The crest of the overflow should be 8 inches above the center of the opening and must be of sufficient length to dispose of the excess without increasing the depth of water to a great extent.

Fig. 18.—Miners' inch and take out box used at Covina, California.

**Fig. 19.—Miners' inch box and take out from pressure pipe at
Riverside, Cal.**
(Courtesy of Irrigation Investigations Office, U. S. Dept. of Agr.)

Fig. 20.—Miners' inch box with overflow wall, for canals.

4.—Special Measuring Devices.

Fig. 21.—Grant-Michell meter; capacity 100 cubic feet per minute.

The Grant Michell meter is known as the Australian meter, having originated in that country. It consists of a four bladed fan fastened to the lower end of a vertical spindle which transmits the revolution of the fan to a gear box at the upper end. This mechanism is suspended from a cast iron bracket over a wrought iron orifice plate placed below the canal bed and built or bolted down into the downstream part of a box divided into two parts by a baffle wall open at the bottom and extending above the water surface. The water passes down through the opening formed by the baffle wall and the box, then flows upward through the orifice and imparts a rotary motion to the fan. The gear box forms the recording device, which consists of a series of dials giving a continuous record in acre inches and fractions, or in cubic feet. The fan, spindle and gear box are removable and portable and can be used for several boxes. The discharge depends on the size of the orifice plate and on the difference in elevation in the water surface upstream and downstream. The size of the meters is generally based on a 3 inch loss of head, but may be designed for less. The orifices range from 9 to 40 inches in diameter and are used for discharge of 1 to 20 cubic feet per second. The serious objection to this meter is the high cost, ranging from \$60 for the smaller one to \$250 for the larger one. These prices are the catalogue prices of Geo. Kent, Ltd., 199-204 High Holborn Street, London.

5.—Measurement of Discharge by Obtaining Velocity of Flow and Cross Section of Flume or Canal.

This method is best adapted to the measurement of large volumes of water when the installation of a weir is not feasible because of lack of grade or because of the large volume of water. The method depends on the principle that the discharge in cubic feet per second is equal to the area of the cross section of the stream in square feet multiplied by the velocity in feet per second. The following principles will give a better understanding of this method of measurement.

1st. The velocity in a canal varies with the form of the channel, the smoothness of the sides and bottom and the grade.

2nd. The velocity varies in different portions of the channel, being smallest near the bottom and the sides and greatest on the center line of the channel just below the surface.

3rd. In a given channel the velocity increases with an increased volume of water in the channel. For instance a flume 3 feet wide carrying water to a depth of 1 foot with an average velocity of 2 feet per second gives a discharge of 6 cubic feet per second. When it carries a depth of 2 feet the area of cross section is doubled and the velocity will be increased to about 2.55 feet per second giving a discharge of 15.80 cubic feet per second which is more than double the first amount.

To obtain the velocity the following methods are commonly used:

1st. Surface floats of chips or other material.

2nd. Rod floats of bottles, tubes or rods.

3rd. Current meter.

To obtain the velocity with surface floats or rod floats the procedure is the same. It is carried on as follows: Select a straight section of canal at least 50 feet long where the cross section is uniform and the flow not affected by obstructions. Lay off the course by placing two wires across the canal or simply stakes at the desired distance apart which may be 50 or 100 feet. Place the float above the upper wire and time the float for its travel over the course. The distance in feet divided by the time in seconds gives the velocity of the float in feet per second. When a rod float is used it must be weighted at the lower end so that it will float vertically. This may be done by placing weights in the bottle or tube or by wrapping lead or wire at the lower end of the rod or simply tying a stone to the end of a stick. Rods $1\frac{1}{2}$ to 2 inches in diameter should be used. The length of the rod should be such that it will nearly touch the bottom. The velocity obtained with a rod float will represent the average velocity, but the velocity obtained with a surface float is 20 per cent. greater than the average velocity and must therefore be multiplied by 8-10 to give the average velocity.

To obtain the discharge accurately it is necessary to subdivide the cross section into partial areas bounded by imaginary vertical lines extending from the bottom of the canal to the top of the water surface and obtain the velocity for each one (Fig. 22). The widths of these areas are marked by tags placed on a wire or marks on a plank spanning across the canal and the depth of water at each tag is obtained by soundings or measurements with a graduated rod or rule. The width in feet multiplied by the average of the two depths for each section will give the number of square feet in the section. This product multiplied by the velocity in feet per second will give the discharge for each partial area and the sum of discharges of each partial area will give the total discharge.

Fig. 22.—Subdivision of canal cross section for measurement of discharge.

The velocity is obtained as explained above by placing the floats so they will travel as nearly as practicable between the tags or marks. It is difficult to get the floats to travel straight down the stream and often the inaccuracy due to this can not be avoided. When rod floats are used, rods of different lengths are usually necessary.

For an ordinary trapezoidal section a less accurate but more expedient procedure is to obtain the total area of the cross section of the channel by multiplying the depth by the average width (which is the sum of the top width and bottom width divided by two) and to multiply the area, thus obtained, by the average velocity. The average velocity is found as explained above, using either surface floats or rod floats.

In case the waterway is a flume the width in feet multiplied by the depth of water in feet will give the cross section.

Current meter.

The current meter generally used to measure the flow in canals consists of a small wheel made up of vanes or cups connected to a rod about which it revolves. The wheel when placed in the flowing water is set in motion by the action of the current and the revolutions are transmitted to a recording or sounding apparatus. By noting the time and the revolutions, the number of revolutions per second are obtained. The velocities corresponding to the number of revolutions are known for each current meter.

A current meter is expensive and is not likely to be possessed by the ordinary irrigator. For that reason a detail description of its use is not given.

Rating station and rating flume.

A rating station is a section of canal the discharge of which is known for different depths of water. To obtain the relation of depth to discharge it is necessary to rate the station. This is done by the measurement of discharge for a wide range of depths, from which a table is prepared giving the discharge at any depth. The rating station should be selected where the waterway has a straight reach of nearly uniform cross section above and below and there should be no obstructions to interfere with the flow, such as gates below it. The selected section should have a channel which is not liable to change by scouring or silting. To insure a permanent section a rating flume, which is a short section of flume, is often used. The depth of water is indicated by a graduated rod placed on one side of the canal or by graduations marked on the side of the flume.

Automatic registers.

The volume of water delivered over a weir or the discharge of a ditch flume or creek obtained by measurements at a rating station or rating flume will vary with the fluctuations in the water level. Where it is desired to have a continuous record of the quantity of water, automatic registers have been used. These registers are of different types. They can, however, be classified in two classes. They all consist of a clock, a float and a cylinder or drum to which is fastened a sheet of paper on which the depth of water at different times is recorded by a pencil or pen.

With one class of register the cylinder is placed vertically and is rotated by a clock which gives it one revolution a week. The pencil is connected to the float which is placed in a well or box built on the side of the weir box or rating flume and connected with the water through an orifice. The fluctuations in water level cause a rise and fall of the float and a corresponding movement of the pencil which is recorded on the sheet placed on

the drum. Fig. 23 shows a simple form of register of this class used in southern California, the cost of which is about \$40.

The other class of register differs from the first class in that the cylinder is placed horizontally and is rotated by the float instead of by the clock and the pencil is carried parallel with the cylinder by connections with the clock. In each case the record obtained is the result of two motions which give an irregular line showing the fluctuations and giving the depth of water at any time. The various types of registers are illustrated and described in Bulletin 86, part 1, of the Office of Experiment Stations of the U. S. Department of Agriculture, Washington, D. C.

The cost of registers ranges from about \$40 upwards and for that reason they are seldom used for the measurement of water delivered to irrigators. They are, however, of much value in the operation of a system when installed at the head of laterals.

Fig. 23.—Automatic register used at Riverside, California.

(O. E. S. Bulletin 86, Part I., U. S. Dept. Agr.)

III.—CONVEYANCE OF WATER FOR THE IRRIGATION SYSTEMS OF BRITISH COLUMBIA.

TYPES OF IRRIGATION SYSTEMS.

The topography of the land of the irrigated districts of British Columbia is often very rough and the land irrigated is generally rolling as compared to irrigated land in most of the arid region of the United States. Because of the character of the topography the construction of an irrigation system is expensive and difficult. Ordinarily the main canal which heads at the diversion dam, is excavated on the steep hillsides and continued around the hills, skirting the land to be irrigated. The main laterals or main branches head at the main canal and, where possible, run down the ridges which separate the smaller valleys which make up the entire body of land covered by the system. These laterals either supply directly the farms or are the source of supply for smaller laterals. A large part of the main canal is often excavated in porous material and fissured rock and frequently it must cross canyons or depressions. Open canals have been used where possible; flumes placed on benches cut in the side hill have been used where the side hill was too steep, where the material was too porous, or where the excavation of an open canal was impossible or too expensive, and flumes on trestles or wooden pipes have been used to cross depressions.

Because of the low winter temperature which will cause freezing of water in open canals, at least two irrigation companies have used in the place of open canals for the main as well as for the distributaries, a system of wooden pipes buried in the ground below the reach of frost in order that the irrigation system could be used for domestic supply as well.

The distribution system consists of all laterals and branches necessary to deliver water to each farm. The topography of the land is such that the laterals must often be placed on grades that are too steep for earth ditches and on irregular slopes where the depressions must be crossed by flumes or pipes. Because of this and also because of the small volumes of water usually carried by the laterals, wooden flumes and wooden pipes have been extensively used. Where wooden flumes are used they are placed as much as possible on mud sills resting on the ground and the depressions are crossed on trestles. Where pipes are used they are usually under more or less pressure but occasionally they may be placed practically on grade with very little or no pressure on them, in which case they act more as a covered flume.

The systems of British Columbia can be classified into the following types based on the form of construction used.

1st. Those which consist of an open main canal and of open laterals, (either open ditches or flumes), and to which class belong the irrigation systems at Keremeos, Penticton, and Walhachin, and parts of the systems of White Valley Irrigation Company, Summerland, Naramata.

2nd. Those which consist of an open main canal and of pipe line distributaries such as the Kelowna Irrigation Company and the Fruitlands irrigation system near Kamloops, the latter consisting of a concrete lined canal and cement pipe.

3rd. Those which consist entirely of pipe lines, both for mains and laterals such as the Kaleden system and part of the Summerland system.

As regards the cost of installation the first type has the advantage that the cost per acre of the distribution system is less than that of a wooden pipe system. For ordinary conditions it is roughly estimated that a wooden flume system will cost one-half as much as a wooden pipe system. For very rough land requiring a great deal of fluming on high trestles, the comparison in cost would not be so favorable to wooden flume. As far as durability is concerned, the life of a well constructed wooden flume should be between 8 and 12 years. The life of a wooden pipe which is full only part of the time is problematical; it depends somewhat on the kind of wood and on the soil in which it is placed. In Idaho 4 in. x 4 in. wooden posts used for lot corners, made of the best fir and painted, have been almost completely destroyed in one year. There are a number of instances where wooden pipes have gone to pieces in four or five years or even less. However, if the pipe is made of good selected material, free from sap wood, the life should be from ten to fifteen years for a wooden pipe empty part of the year. The life of wooden pipe which is kept constantly full and buried to such depth as to prevent freezing, would be considerably greater, probably 20 to 30 years provided the soil in which it is buried does not contain injurious salts. Were it not necessary to prevent the water in the pipe from freezing, it is my opinion that the life of a wooden pipe kept constantly full and under sufficient head for the wood to be saturated, would be increased if it was laid above ground not in contact with the soil.

As far as the cost of maintenance is concerned, a wooden flume system requires frequent repairs, tarring, and calking, the cost of which would be greater than the maintenance of a pipe system.

It is impossible to represent numerically the above statements with any degree of accuracy because of the varying conditions. Roughly they may be represented as follows:

Annual cost of wooden flumes and wooden pipes given in per cent. of first cost:

For wooden flumes, life 8 to 12 years—

Annual maintenance and repairs distributed over entire life..	5	per cent.
Sinking fund for renewals.....	9	" "
Interest on capital invested.....	6	" "
	<hr/>	
Total	20	" "

For wooden pipes empty part of the time, life 10 to 15 years—

Maintenance and repairs.....	2	" "
Sinking fund for renewal.....	7	" "
Interest on capital invested.....	6	" "
	<hr/>	
Total	15	" "

For wooden pipes always full, life 20 to 30 years—

Maintenance and repairs.....	1	" "
Sinking fund for renewal.....	4	" "
Interest on capital invested.....	6	" "
	<hr/>	
Total	11	" "

These figures show that the annual cost which must be provided for to maintain and renew a system and pay interest on capital invested is 20 per cent. for a wooden flume system, 15 per cent. for a pipe system part of the time, and 11 per cent. for a pipe system always full. These costs are in the ratio of 1.8, 1.3 and 1. Therefore a flume system is more economical than

a wooden pipe system, which can be kept full of water only part of the time, when the cost of the wooden pipe system would be in excess of 1.3 times the cost of the flume system. Also the flume system is more economical when the cost of a wooden pipe system which can be kept full of water all the time is 1.8 times the cost of the flume system. As stated above, a wooden pipe system under average conditions will cost about twice as much as a wooden flume system; therefore, if the above cost alone is considered a wooden flume system is more economical. But there are other relative advantages and disadvantages which should be considered.

The third type of system—that is, the wooden pipe system which can be kept full all the year around without freezing—has the advantage that it can be used for domestic supply. The other two types require a separate domestic system if domestic water is desired. But it is not always possible to combine the two, for often the source of supply from which the irrigation water is obtained may be frozen in the winter or it may be so polluted that it is not safe drinking water and if it must be filtered or treated to purify it, it would be very poor economy to have to purify the irrigation water as well as the domestic water which are carried in the same pipe. If these conditions exist a separate domestic system is preferable.

PERMANENT CONSTRUCTION.

The short life of wooden flume and wooden pipes and the increasing value of water have led to more permanent and better class of construction throughout the arid region. Wooden flumes on trestles are being replaced by steel flumes; wooden flumes resting on the ground or bench flumes which were necessary to carry the water on steep hillsides or through porous ground, are being replaced by concrete flumes and concrete lined channels. Concrete linings are being constructed wherever the seepage losses must be prevented because of the value of water loss or because of the damage caused to adjacent land by the seepage water. Concrete pipes, both plain and reinforced, which a few years ago were only used in southern California, are now being used to some extent in many of the irrigated districts of Washington, Oregon, Idaho, and other western states and their use is growing. The use of plain concrete pipe is, however, limited to small heads and concrete pipe reinforced with steel can only be used for moderate heads. So far reinforced concrete pipe has been used only where pressure heads are under 100 feet, and some manufacturers of reinforced concrete pipe will guarantee them for heads as large as 150 feet. But it can not be expected that cement pipe will replace wooden pipe where pressures are large and as much of the land covered by irrigation systems in British Columbia is irregular and the surface has a steep slope which often produces high pressures, the use of reinforced concrete pipe can not be adopted in general. For such locations wooden pipes, especially if they can be kept full and protected from freezing, are the best solution. On steep slopes which are fairly uniform with no deep depressions, it is possible to so regulate the pressure that cement pipes can be used.

During the past two years some of the irrigation companies of British Columbia have realized the economy of improved method of construction and some of the work which has been done and is being done is equal to any in the country. Excellent examples of permanent construction are found on the systems of the Kelowna Irrigation Company and the South Kelowna Company, near Kelowna, and the Fruitlands Irrigation and Power Company, near Kamloops. Some of the systems installed and others which

are in the process of construction will cost upwards of \$50 an acre and probably as high as \$100 an acre. Those systems which are installed and which consist largely of wooden flumes or wooden pipes, will before very long require renewal to a large extent, and where these systems have passed in to the hands of municipalities this cost of renewal will have to be met directly by the farmers or fruit growers of the municipality. The information given in the following pages will, it is hoped, be of assistance in the reconstruction of old systems and in the installation of new systems. The subject has been subdivided and is taken up in the following order:

- 1st. Seepage losses in canals.
- 2nd. Canal linings to prevent seepage losses.
- 3rd. Steel flumes.
- 4th. Plain concrete pipes.
- 5th. Reinforced concrete pipes.

CONVEYANCE LOSSES OF WATER IN CANALS.

All irrigators are well acquainted with the fact that the losses in conveying water in earth canals are in many cases very large and with newly excavated canals are often so great that it is difficult to deliver water at the lower end. On irrigation systems with unlined canals these losses usually range from 25 to 60 per cent. of the water diverted and taken in the canal system, and there are many instances where the losses are much greater. In two miles of canal of the Canyon Creek Irrigation Company, near Kelowna, the losses amounted to 60 per cent. of the water entering the canal. This is not an exceptional case for on some California canals losses of 64 per cent. per mile have been observed. It is safe to state that on an irrigation system consisting of earth ditches, only 50 per cent. of the water diverted is delivered to the fields.

The water lost by seepage disappears through some underground drainage channel or raises the water table of the lands adjacent to and below the canal. This causes the waterlogging of the land or accumulation of alkali salts on the surface. This effect, combined with wasteful irrigation, has been the cause of over ten per cent. of the irrigated lands of the West becoming unfit for crop production. On one project in eastern Washington after only the first irrigation season considerable land was waterlogged and in some portions the water table had risen sufficiently to cover the land several feet deep. These damages alone, in many cases, justify the expense of lining the canals. But even if injury by waterlogging is not considered, there are many localities where the water is sufficiently valuable to make the lining of canals to stop the loss of water a paying proposition. The amount of money which one is justified in spending will be in proportion to the extent of the losses.

1.—Extent of Seepage Losses in Canals.

The extent of seepage losses depends on many factors such as porosity of the soil, the form of cross section, the size of the canal, the number of seasons the canal has been operated, the amount of silt in the water, the velocity of flow, the depth to the water table, etc.

The most valuable general observations as regards the amount of these losses are those of the Irrigation Investigations Office of the United States Department of Agriculture. From series of measurements on seventy-three ditches in the western states, they have found that the average loss per mile of ditch is 5.77 per cent. of the entire flow; the measurements range from a maximum of 64 per cent. per mile to a slight gain in a few cases. Large

Fig. 24.—Concrete lined canal of Fruitlands Irrigation and Power Company, Kamloops, B. C.

Fig. 25.—Concrete lined canal of Fruitlands Irrigation and Power Company, Kamloops, B. C.

**Fig. 26.—Concrete lined canal of Kelowna Irrigation Co.,
Kelowna, B. C.**

Fig. 27.—Method of using forms for backfilling to prepare canal for concrete lining, Fruitlands Irrigation System, Kamloops, B. C.

Fig. 28.—Earth canal ready for concrete lining, Fruitlands Irrigation System, Kamloops, B. C.

Fig. 30.—Forms in position for concrete lining, Fruitlands Irrigation System, Kamloops, B. C.

Fig. 31.—Construction of concrete lining, Kelowna Irrigation Company, Kelowna, B. C.

canals in general lose less in proportion than small ones. The measurements show that the loss per mile averages about 1 per cent. for canals carrying 100 cubic feet per second or more, about $2\frac{1}{2}$ per cent. for canals carrying 50 to 100 cubic feet per second, $4\frac{1}{2}$ per cent. for canals carrying 25 to 50 cubic feet per second, and $11\frac{1}{4}$ per cent. for canals carrying less than 25 cubic feet per second.

For some purposes it is preferable to know the extent of seepage expressed in cubic feet of water per day per square foot of wetted area of the canal. This is equivalent to stating the depth of water in feet lost each day. A number of measurements have been made in various parts of the country and some of these have been assembled by F. W. Hanna, Project Engineer of Boise U. S. Reclamation Service Project, in Idaho, who states that from careful consideration of the data assembled, it would appear that a seepage loss of 0.5, 1 and 1.5 cubic feet per square foot wetted surface per day might be assumed for canal losses respectively for rather impervious, mediumly pervious and rather pervious soils. Based on the above figures and assuming a common form of cross section, he obtains the following results as the seepage loss per mile expressed as per cent. of flow.

Capacity of canal.	Loss in per cent. of flow per mile.		
Cubic feet per sec.	For rather impervious soil.	Mediumly pervious soil.	Rather pervious soil.
10 or less.....	4	8	12
11 to 25.....	2.5	4.5	7
26 to 50.....	1.5	3.	4.5
51 to 75.....	1.	2.	3.
76 to 100.....	.75	1.5	2.5

The above table gives results which agree with those obtained by the Irrigation Investigations Office as closely as can be expected because of the numerous factors involved.

2.—Evaporation Loss From Water Surface of Canals.

The losses above stated include seepage and evaporation, but contrary to the general belief, the losses of evaporation from flowing water in a canal are insignificant when compared with those of seepage. It has been shown that the losses of seepage and evaporation per day might be assumed at 0.5, 1 and 1.5 cubic feet of water per square foot of wetted surface, respectively for rather impervious, mediumly pervious and rather pervious soil. These are equivalent to losses of water 6, 12 and 18 inches deep. As compared to these figures, the evaporation from water surface for the irrigation season will generally be about $\frac{1}{4}$ of an inch per day, which is from 25 to 75 times less than the above seepage losses. Seepage and evaporation measurements made at Twin Falls, Idaho, and reported by Elias Nelson (Bulletin 58, University of Idaho) show that the evaporation ranged from less than 1 per cent. to less than 2 per cent. of the total loss in the canals. On one of the largest systems in the San Joaquin Valley, California, the total length of canals is 165 miles and the total seepage loss was 28 per cent. and 30 times greater than the evaporation loss. These and other numerous experiments show that the evaporation losses in the conveyance of water are so small as compared with the seepage losses that they are of no importance.

PREVENTION OF SEEPAGE LOSSES IN CANALS.

To prevent the loss of water in conveyance lining the canals with different materials has been tried. Those used or experimented with are con-

crete, wood, asphalt, oils, and clay puddle. A good lining should fulfill the following requirements: it should be water tight, prevent the growth of weeds, stop burrowing animals, be strong and durable, and preferably not affected by the tramping of cattle. From investigations made by the writer in 1906 and from more recent experience as regards the efficiency of the different types of linings, the following results can be anticipated:

1st. A good oil lining constructed with heavy asphalt road oil applied on the ditch sides and bed at the rate of about 3 gallons per square yard, will stop 50 to 60 per cent. of the seepage.

2nd. A well constructed clay puddle lining is as efficient as a good oil lining.

3rd. A thin cement mortar lining about 1 inch thick, made of one part cement to four of sand, will prevent 75 per cent. of the seepage.

4th. A first-class concrete lining, 3 inches thick, made of one part of cement to two of sand and four of gravel, will stop 95 per cent. of the seepage.

5th. A wooden lining when new is as efficient as a concrete lining, but after two or three years, repairs and maintenance will become an important item and by the end of eight or ten years, it will necessitate complete renewal.

The cost of an oil lining where oil can be bought at California prices (about 2 cents a gallon) is about $\frac{1}{2}$ cent per square foot. Cement mortar lining 1 inch thick costs about 3 to 4 cents per square foot. Cement concrete 2 inches thick costs about 6 cents and 3 inches thick about 8 cents a square foot. These prices do not include the trimming and preparation of the ditch before the lining is put on, which would add from $\frac{3}{4}$ to $1\frac{1}{2}$ cents per square foot. The cost of a clay lining depends greatly on the nearness of the canal to suitable clay. If clay is close at hand, it can be hauled and spread on the canal, then either tramped in by cattle or worked in by dragging over it, at a cost of less than 1 cent per square foot, but there are localities where the writer has seen enough money spent on clay linings to pay for a good concrete lining. Wooden lining has been used in very few cases and the cost of such a lining built of 2 inch lumber nailed on sills and side yokes will not be less than that of a 2 inch concrete lining and not nearly as durable.

The disadvantages of the cheaper linings are the following: An oil lining stops only a part of the seepage losses, and while it will resist erosion well, it probably will not prevent the growth of weeds for more than one season unless a high velocity is used, and it will not stop the activities of burrowing animals. Another serious objection is that suitable oil would be hard to obtain in British Columbia at a reasonable cost. Oil linings have not been sufficiently tested to determine their durability.

Clay puddle will not prevent the burrowing of animals, and weeds grow rapidly, especially since the velocity of the water must be small in order to prevent the eroding or washing of the lining.

A concrete lining has none of the above disadvantages and it meets the requirements of a good lining better than any other material. The only objection is its higher first cost. This, however, can be partly balanced, especially on side hill work, where a new canal is to be constructed, by using a higher velocity and a smaller cross section, thus decreasing the cost of excavation. Where an old canal must have its capacity enlarged, this may be done either by lining the canal which will give a higher velocity because

of the smoothness of the channel, or by increasing the cross section by excavation. The cost of extra excavation, especially on side hills through hard material, may be greater than the cost of lining.

Concrete lining will usually prove to be the most economical type of lining to use in British Columbia. However, where good clay is available and where it is not financially feasible to use concrete, clay puddle may be used to advantage in improving leaky earth canals when the velocity of flow is under 3 feet per second.

1.—Concrete linings.

The earliest use of concrete linings was in southern California about 1880 when the increasing value of water made it necessary to do away with losses. Since that time practically all of their canals, which are comparatively small, carrying less than 100 cubic feet per second, have been lined with concrete and in some cases replaced with concrete pipes. Until recently very little concrete lining had been done outside of that region, but during the last few years concrete lined canals have been constructed on many of the projects of the United States Reclamation Service and on numerous private projects. There are now several examples in California, Oregon, Nevada, Washington, Idaho and other states and during the past two years some excellent work has been done in British Columbia. The Fruitlands Irrigation and Power Company near Kamloops has lined about 6 miles of its main canal which averages $3\frac{1}{2}$ feet in depth, 4 feet wide at the bottom and $7\frac{1}{2}$ feet wide at the top, with an average thickness of concrete of 3 inches and when the system is completed there will be about 15 miles of concrete lined canal. (Figs. 24, 25). The Kelowna Irrigation Company, near Kelowna, has lined the upper 5 miles of its main canal, $2\frac{1}{2}$ feet deep, 3 feet wide at the bottom, and $5\frac{1}{2}$ feet wide at the top, with 3 inches of concrete (Fig. 26). The remaining 7 miles of the canal, which is 1.5 feet deep, 2 feet wide at the bottom and $4\frac{1}{2}$ feet wide at the top, is lined with 2 inches of concrete.

Form of cross section, and thickness of lining.

Unlined canals in earth are usually constructed broad and shallow with the side slopes varying according to the character of the soil. This may be as steep as $\frac{1}{2}$ horizontal to 1 vertical for hardpan or very firm soil, or as flat as 2 to 3 horizontal to 1 vertical for loose sandy soil. For a lined canal it is more economical to use a comparatively narrow deep section and fairly steep side slopes. This reduces the excavation and the amount of concrete. The side slopes must not be much steeper than the slope on which the ground will stand or the earth pressure may be sufficient to push the sides in and break the lining. The side slope and the thickness of the lining are dependent upon each other and they vary with the depth of the canal, the character of the soil and the method of construction. Generally the flatter the side slopes, the thinner can the lining be made. In southern California fairly satisfactory results have been obtained on many systems with linings 1 inch or less in thickness. But because of extremes in temperature and the low winter temperature, it is probable that such thin linings would not be very satisfactory in British Columbia. There are no good examples of very thin linings built where the winter temperature is low. The writer has seen four miles of canal in eastern Washington lined with $\frac{1}{2}$ to $1\frac{1}{2}$ inches of concrete. The lining was rather badly cracked, but this was largely due to poor workmanship. It made it possible, however, to carry water over this length of canal which was impossible before its construction.

For the ordinary conditions in British Columbia the following thickness of concrete lining and side slopes should be used. For a canal 2 to 4 feet deep excavated in an ordinary firm soil which will stand naturally on a slope not flatter than 1 or $1\frac{1}{2}$ horizontal to 1 vertical, use a concrete lining not less than 3 inches thick built on a slope of $\frac{1}{2}$ horizontal to 1 vertical, or a lining not less than 2 inches thick built on a slope of 1 horizontal to 1 vertical. For loose soil which will stand naturally on a slope of 2 or 3 horizontal to 1 vertical use a 3 inch lining placed on a slope of 1 vertical to 1 horizontal. For canals 12 to 18 inches deep use a minimum thickness of 2 inches.

When side slopes of $\frac{1}{2}$ horizontal to 1 vertical are used, the form of cross section requiring the least concrete will have a bottom width equal to 94-100 of the square root of the area in square feet and a depth equal to 76-100 of the square root of the area. When the side slopes are 1 horizontal to 1 vertical, the bottom width and depth will be 61-100 and 74-100 respectively of the square root of area.

Shrinkage and expansion.

No matter what the thickness is, unless the concrete is reinforced with steel, or expansion joints provided, cracks are to be expected because of the contraction or shrinkage in the winter. These cracks will usually be fine cracks occurring at more or less regular intervals and the leakage through them will be small and often silt up. For better appearance and to distribute the cracks at uniform intervals, the lining should be laid in sections or strips 6 to 8 feet long.

Effect of frost.

Frost should have no effect on the lining if the soil is well drained. But when the soil contains water, freezing will produce heaving of the soil which will not be resisted even by thicker linings than those recommended. Usually a canal which must be lined is located where the water drains too readily from the soil, but if the canal is located where water is liable to collect behind the lining, a drain should be provided. The drain should be a 3 or 4 inch tile placed below the floor of the canal lining in a trench 12 inches deep, located along the center line of the canal and the tile covered preferably with loose rock, gravel, sand, or other porous material. To discharge the water collected cross drains should be placed every 400 or 500 feet or wherever there is a drainage channel. The tile may be omitted and the trench filled entirely with rock or gravel but this is not as efficient.

Method of construction of concrete linings.

The details of construction in lining canals usually vary with the ideas and judgment of the men in charge of construction. There are two general methods of construction.

The first method of construction requires forms behind which the concrete is placed. The second method requires no forms, the concrete being spread on the bottom and sides of the canal much in the same manner as for sidewalk work. The first method is used when the side slopes are steeper than 1 horizontal to 1 vertical. The second method is used for side slopes of 1 to 1 or flatter.

Construction of concrete lining by means of forms.

This method has been used by the Fruitlands Irrigation and Power Company, near Kamloops, by the Kelowna Irrigation Company and the South Kelowna Irrigation Company. It has also been used extensively on a num-

ber of canals in southern California. It is well adapted to canals less than 8 or 10 feet wide at the top. The method is as follows:

For a new canal the excavation is made about 6 inches larger on each side than the finished earth section when ready to receive the lining. For an old earth canal all vegetable matter is removed and if necessary more material taken out in the same manner as for a new canal. In each case the bottom is brought carefully to grade. To shape the canal ready for the lining, the means used on the canals of Fruitlands Irrigation system near Kamloops were wooden forms 6 feet long. These forms are placed in position in the excavated section as shown in Fig. 27, earth is thrown in between the form and the earth bank and well puddled with plenty of water which was pumped for this purpose. This was found much better and more economical in labor than tamping the earth. Even when using a very wet mud, the ground drains sufficiently to allow the removal of the forms next morning. This leaves a very smooth ditch with moist banks ready to receive the concrete lining (Fig 28). The wooden form is a trapezoidal trough with no bottom; the sides are tongue and groove or shiplap boards nailed to frames made of 2 in. x 4 in. scantlings cross braced for rigidity.

To place the concrete forms similar to the earth forms are used (Fig. 29). This concrete form is smaller than the earth form by the thickness of the lining and is built so as to give a greater thickness of concrete at the

METHOD OF CONCRETE LINING CANALS WITH FORMS
AS USED BY FRUITLANDS IRRIGATION AND
POWER CO., LTD.

Fig. 29.

corners where the floor and sides come together. The concrete work follows shortly after the earth forms are taken off when the banks are still moist. The concrete forms are placed in position in the finished earth ditch, but instead of placing them continuously as the earth forms, only every alternate form is put in place (Fig. 30); then the concrete, which is mixed wet, is placed between the form and the earth and well stirred or cut with thin bars. To protect the earth slope when pouring the concrete mixture, it is well to cover the earth slope with thin galvanized iron sheets, which are pulled up as the concrete is poured in. The sides and bottom are put in at the same time. This gives a good connection at the corners which is very desirable. To do this it is necessary to block the forms above the ground by 3 inches (the thickness of the lining). To hold the concrete at the ends of the sides and also to hold the form the right distance away from the earth side, 2 inch by 3 inch pieces are placed edgewise between the earth slope and the wooden forms. When the sections have hardened the forms are removed and moved ahead to the adjacent section. In order that the ends of the form will rest on the two adjacent completed sections the forms should be a little longer than 6 feet (the length of a section), preferably 6 feet 6 inches. After the removal of the forms the concrete must be prevented from drying out too quickly, this may be done by protecting it with burlap kept wet by sprinkling or by letting water in the completed section as soon as possible. It is preferable to keep the concrete moist for several days after the removal of the forms.

The proper handling of the forms especially on rough side hill work will materially affect the cost. When the lining is started from the upper end of a canal and the work progresses downstream, probably the most economical manner is to place the forms in position for a length of canal which can be lined in one day and begin the concrete work at the downstream end and extend it upstream. The concrete at the downstream end hardens first and this allows the removal of the downstream forms which are carried downstream in the ditch and placed in position at a distance from their previous position equal to the length of canal lined in one setting of the forms. This procedure allows continuous work and does away with the necessity for carrying the forms around the side hill.

Joints.

The lining is done in strips in order that all contraction cracks will occur at the joints which are places of weakness. To separate the sections more distinctly the edges of the sections may be painted with oil or a strip of tarred paper may be used. By using short sections the contraction cracks are very small and the seepage through them is negligible. It is probable that the cracks in most cases will silt up.

Expansion joints.

Ordinarily expansion joints are not necessary but there are some classes of soil in which any seepage through cracks will cause the settlement of the soil and destroy the lining, in which case it may be desirable to do away with all open joints to prevent seepage by using some form of expansion joint. This, however, is quite uncommon but occasionally occurs where the soil has probably been formed from the coarser material carried by the flood waters of a heavy cloudburst and deposited in small fan shaped valleys or benches. The lack of rainfall and of the occurrence of further cloudburst, has left the soil in an unsettled condition and any seepage water passing through the concrete lining may carry off the finer soil particles into the subsoil below and cause a settlement.

For these conditions it may be advisable to use expansion joints spaced about 12 feet apart and omit all other joints. However, the writer believes that the soil can be thoroughly settled by running water in the excavated canal prior to the construction of the lining. The expansion joint, if desired, could be made by imbedding in the edges of the adjacent section a metal tongue about 4 inches wide. This tongue may be of galvanized iron well painted with oil to prevent adhesion of the concrete.

Method used near Kelowna by Kelowna Irrigation Company.

The method was very similar to the one described above. The main difference was that no separate earth forms were used. The concrete forms were placed in position in the excavated ditch and galvanized iron metal plates were put outside of the concrete form and held away from it by pieces of timber of the thickness of the lining (Fig. 31). The earth back-filling was placed against these plates and the concrete was poured in between the plates and the concrete forms. The plates and pieces of timber were pulled out as fast as the concrete was poured in.

The above methods of lining by means of forms are limited to side slopes steeper than 1 to 1, because when using a wet mixture even with side slopes between $\frac{1}{2}$ to 1 and 1 to 1, the forms will tend to raise. Bolting the forms together will help to keep them in position.

Construction of concrete lining without forms.

This method of construction has not been used in British Columbia but it is used extensively on irrigation canals in California and other states where concrete lining was necessary. It is the method to use for side slopes of 1 to 1 or flatter and is well adapted to large canals. While the first method is usually preferable for new canals on side hills, because steeper side slopes can be used, the second method may be preferable in the valley or in level land and especially in loose sandy soil which will stand naturally on slopes of 2 horizontal to 1 vertical or more.

The method used in preparing the excavated earth canal for the lining and in applying the concrete lining varies. One of the best methods which has been used by the Gage Canal Company of Riverside, California, is as follows:

Preparation of earth canal (Fig. 32). Place the grade stakes 20 feet apart along one side of the ditch at a distance of 1 foot from the top of the sloping side. Hold a level rod or cross section rod across the ditch with one end resting on the grade stake, set the corresponding grade stake on the other side and put the bottom stakes in position by measuring down from this rod. By means of these stakes the bottom is cut to grade. To trim the side slopes, iron strips 1 inch wide, $\frac{1}{4}$ inch thick and of suitable length are driven edgewise in the sloping sides 3 feet apart, and extending up and down the slopes. The lower ends of these bars are placed in line by means of a line stretched between the bottom grade stakes and the proper slope is given to the bars by using a specially constructed slope level, which consists of a wooden rod on which a level bubble is placed, the bubble coming to the center when the rod is on the desired slope. The iron bars when in position, are guides for a sharp iron straight edge with which all irregularities are shaved off and hollow places filled in and well tamped.

A modification of this method would be to locate the top and bottom grade stakes by means of a templet of the same form as the finished ditch, the templet being equipped with a plumb bob or spirit level will indicate when it is in position (Fig. 33). Then stretch longitudinal lines between the stakes and grade approximately to these lines and finish the dressing

METHOD OF TRIMMING CANAL USED ON GAGE CANAL, CALIFORNIA.

Fig. 32.

ALTERNATIVE METHOD OF TRIMMING CANAL.

Fig. 33.

by placing flatwise 2 inch by 4 inch timbers across the slopes at the distance desired and with a straight edge tamp and level the earth between.

It is important to remove all deposits of vegetable character and the sides and bottom must be well settled to prevent the cracking of the lining. It is well to run water in the ditch before the ditch is prepared and lined.

The placing of the concrete should follow the trimming as soon as possible and if the channel is dry it should be thoroughly moistened by sprinkling. The concrete lining is built in alternate strips or panels. To place the concrete wooden guide pieces of the thickness of the lining are laid across the side slopes at the required distance apart which may be 3 feet or more. The concrete is spread between these studdings and raked to about a uniform thickness, tamped and made smooth and level by means of a straight edge resting on the guide timbers. The floor is finished in the same manner. Fig. 34 shows the completed canal.

Cost of concrete linings.

The cost of concrete lining varies a great deal with the accessibility of the canal, the material through which the canal is cut, the planning of the work, the efficiency of the construction force, the price of labor and material.

The cost of lining with forms is given by the following examples.

The Anaheim Union Water Company of southern California, which has many miles of concrete lined canal, obtained the following unit cost for 1,000 feet of a canal 9 feet wide at the top, 6 feet wide at the bottom and 3 feet deep, lined with average thickness of concrete of about 3 to 3½ inches, with the corner at the bottom made thicker.

Material.	Cost per 1000 feet.
170 barrels of cement at \$2.70.....	\$ 460.00
170 cubic yards of gravel at 65c.....	110.00
Labor of backfilling using earth form.....	254.00
Labor of placing with concrete form.....	212.00
	<hr/> \$1,036.00
Cost per lineal foot, including backfilling, \$1.036.	
Cost per square foot, including backfilling, \$0.0818.	

For 4,070 feet of a smaller canal 2½ feet wide at the top, 1 foot wide at the bottom and 1½ feet deep, lined with 2 inches thickness of concrete, the cost was:

Material.	Total cost for 4070 feet.
180 barrels of cement at \$2.40.....	\$432.00
180 cubic yards of gravel at \$1.25.....	225.00
Total labor for backfilling, mixing and placing concrete.....	270.06
	<hr/> \$927.06
Cost per lineal foot, including backfilling, \$0.228.	
Cost per square foot, including backfilling, \$0.0526.	

The wages paid were:

\$1.75 per day for men using earth form and backfilling.

\$2.00 per day for men mixing and placing concrete.

\$3.00 per day for foreman.

These costs include only the cost of materials in the concrete and the

labor, but do not include cost of engineering, depreciation and interest on cost of forms and plant. These items would be small for the work was done under the supervision of the superintendent of the company who is paid largely for other duties, and the cost of forms and plant was small. The wages and cost of cement are low and the canal was easily accessible, making the cost of lining lower than could be obtained in British Columbia.

On the system of the Fruitlands Irrigation and Power Company, near Kamloops, the cost of lining 12,000 feet of canal 4 feet wide at the bottom, 3½ feet deep, and 7½ feet wide at the top with 3 inches of concrete averaged as follows:

Hauling forms, placing forms, backfilling with earth forms..	\$.18	per lineal foot
Cost of cement.....	.50	" " "
Cost of sand and gravel.....	.16	" " "
Cost of placing concrete forms, mixing and placing concrete	.30	" " "
Gasoline for concrete mixers.....	.01	" " "
<hr/>		
\$1.25		
Cost per lineal foot, including backfilling, \$1.25.		
Cost per square foot, including backfilling, \$0.105.		

The concrete used was a mixture of 1 part of cement to 3 of sand and 4 of gravel. The cement cost \$3.40 delivered on the job. The above cost was obtained where the canal was easily accessible along the foothills and the forms and concrete mixer could be easily moved along the banks of the canal. The cost of engineering, administration, interest and depreciation on cost of plant are not included in the cost.

On several thousand feet of canal where the canal was excavated on a steep rocky side hill, it was very difficult to deliver the concrete and the total cost of the above items was \$1.72 per lineal foot or 14½ cents per square foot.

On the system of the Kelowna Irrigation Company, which has about 12 miles of lined canal, no separate form was used for backfilling the earth; instead metal plates were held away from the concrete forms by studding of the thickness of the concrete inserted between concrete forms and the plate as described above. The cost of lining 24,000 feet of main canal, 3 feet wide at the bottom, 2½ feet deep, and 5½ feet wide at the top gave the following average cost:

Making rock drain below floor, hauling forms, placing forms and backfilling	\$.21	per lineal foot
Cost of cement and hydrated lime.....	.47	" " "
Cost of sand and crushed rock.....	.16	" " "
Mixing and placing concrete.....	.49	" " "
Miscellaneous	.03	" " "
<hr/>		
Cost per lineal foot.....	\$1.36	
Cost per square foot.....	.158	

The concrete was a mixture of 1 part of cement to 3 of sand and 5 of crushed rock. Cement cost \$3.20 to \$4.10 delivered. The wages were \$2.75 per day of 10 hours for common labor and \$3.50 to \$5.00 for skilled labor. The cost of engineering, which included location of the canal and the cost of depreciation and superintendence, brought the total cost to 17.73 cents per square foot. As the cost of lining only is considered here the cost of location should not be added. The higher cost per square foot obtained in this case was due to the higher cost of cement, the necessity for building roads to deliver material and move forms and mixer along the

canal and to the placing of a rock drain under the floor of the canal. It was also necessary to rush the work and this probably increased the cost.

The South Kelowna system has started during this summer to excavate and line the upper part of their main canal which is in very difficult ground on very rocky and steep hillside, in some places the excavation alone costing over \$3 a lineal foot. The canal was very inaccessible, requiring the construction of expensive roads to deliver the material and move the mixers. The forms were carried considerable distance around the bluff. This and other difficulties as well as the high cost of cement, brought the cost very high. Cement cost about \$5.25 a barrel delivered at the mixer, and was mixed with 4 parts of sand and 5 parts of crushed rock. The canal was 3 feet wide at the bottom, 3 feet 3 inches deep and 6 feet 3 inches wide at the top. The lining 3 inches thick cost about \$2.15 a lineal foot or about 21 cents per square foot.

Cost of lining without forms.

The main canal on the Gage Canal system near Riverside, California, has a bottom width which varies from 5 to 10 ft. and a depth from $3\frac{1}{2}$ to 4 feet and side slopes of 1 to 1. The contract cost for trimming the canal and placing the lining of cement mortar $\frac{3}{4}$ to 1 inch thick was from $3\frac{3}{4}$ to 4 cents per square foot. This work, however, was done many years ago when labor was cheaper.

The Burbank Power and Water Company of Washington has recently lined 4,100 feet of the main canal which has a bottom width of 6 feet 6 inches, a depth of $2\frac{1}{2}$ feet and a top width of 14 feet. The lining is $2\frac{1}{2}$ inches thick for the bottom and 3 inches thick for the sides. At the top of the sides the lining extends horizontally for 6 inches to form a coping. The concrete was mixed in the proportion of 1 part of cement to 2 of sand and 4 of gravel. The lining was finished by painting with a thin mixture of 1 part of cement to 1 of sand. The contract price was \$12.50 a cubic yard or about $11\frac{1}{2}$ cents a square foot.

The U. S. Reclamation Service has lined 6 miles of the Main South Side Canal on the Boise Project in Idaho, with a concrete lining 4 inches thick. The canal is 40 feet wide at the bottom, 8 feet deep and 64 feet wide at the top. The concrete mixture was 1 part of cement to 3 of sand and 6 of gravel. A finishing coat of cement mortar was floated over the concrete to give it a smooth surface. The work was done at a cost of a little less than 10 cents a square foot excluding the cost of preparing the foundation.

These and many other examples show that for either method of construction and with average conditions and average prices, a concrete lining 3 inches thick should cost from 10 to 15 cents, including cost of backfilling or trimming the ditch to prepare it for the concrete lining and all cost of engineering, depreciation and interest on the equipment necessary for the work. A concrete lining 2 inches thick should cost from 7 to 12 cents. The lower cost in each case should be obtained with very favorable conditions.

Economy of concrete linings.

While concrete linings have many advantages, it is not an economical proposition to line canals indiscriminately without considering all the factors upon which a decision should be based. The problem resolves itself to a comparison between the cost and the benefits derived. The factors which must be considered are (1) cost of construction, (2) cost of maintenance and operation, (3) damages due to waterlogging and alkali, and (4) value of water loss.

When a new canal is to be constructed the choice between an unlined canal and a concrete lined canal will depend largely on the first cost of construction. When there is sufficient fall available, a concrete lined canal can be given a steeper grade than an unlined canal which could not resist the erosion due to high velocity. The steep grade and also the smoother cross section will give a high velocity which will make the necessary size of the canal much smaller. The concrete lined ditch can also be given steeper side slopes which will decrease the excavation. For these reasons, the amount of excavation, especially on side hill work, will be much smaller for the concrete lined canal than for the unlined canal. This will reduce the cost of excavation sufficiently to balance for at least part of the cost of lining, and in some cases where the excavation is in hard material, the concrete lined canal may cost less than an unlined canal. Where there is not sufficient fall available to give the lined canal a steep grade, the comparison will not be quite as favorable but even then a lined canal because of its smooth bed and sides will have a greater velocity than an unlined canal on the same grade, and therefore a smaller cross section, and on side hill work in hard material the saving in cost of excavation will be considerable. Other benefits which must be considered are the decreased cost of maintenance and operation and the greater safety. There are no weeds to contend with, no breaks to mend and consequently the cost of patrolling is eliminated. To this must be added the value of the water saved and the prevention of waterlogging of the land below a leaky ditch. These benefits can not be closely estimated when a new canal is to be constructed but should be considered before deciding the feasibility of a concrete lining.

With existing canals the problem is to prevent the seepage losses or to increase carrying capacity by either enlarging the canal or by lining it with concrete. The extent of the seepage losses can be obtained by measurements, the damages done to adjacent land below and the maintenance of the canal are fairly well known and will furnish sufficient data to estimate what can reasonably be spent in concrete lining. When the capacity of the canal must be increased, the choice is between making a larger unlined canal or to use a lined canal of smaller cross section which will have a higher velocity because of the smoothness of the sides and bed. There are many cases where the value of the water loss alone will justify the improvement of the canals by lining. This is obtained when the value of the water loss will be equal to or larger than the depreciation and interest on the capital invested. As an illustration, if a canal carrying 50 cubic feet per second throughout the irrigation of 4 months or 120 days, loses 3 per cent. per mile, which is not excessive, this loss is equal to a continuous flow of 1.5 cubic feet per second or 3 acre feet, which gives a total of 360 acre feet whose value at \$1.50 an acre foot is \$540. For this case we would be justified in spending per mile a capital, the interest of which plus depreciation is equal to \$540. If we assume interest and depreciation at 8 per cent., the capital is about \$6,700. In most cases this would be more than enough to build a concrete lined canal of that carrying capacity, depending on the velocity which can be used.

STEEL FLUMES.

During the past two seasons several miles of steel flumes have been used on the irrigation systems of the Kelowna Irrigation Company and of the Fruitlands Irrigation and Power Company, near Kamloops. The flumes are semi-circular and are made of metal sheets curved in a semi-circular form with a bead or corrugated groove rolled in each edge of the sheet. The

sheets are put together by means of an interlocking joint formed by overlapping the edges which fit over each other. The joint is made tight by means of a curved rod which fits on the outside of the corrugated groove and a curved bevelled bar or small channel on the inside. The steel rods carry the weight of the flume. The ends are threaded for nuts and pass through the carrier or tie beams which are supported on stringers usually about 16 feet long. The stringers rest on trestle bents to which they are connected by bolts. By screwing the nuts the outside rod is drawn firmly against the flume and the channel or bar presses on the inside making a water tight joint. The method of construction and the completed flume are shown by Figs.

There are two makes of flume on the market, one known as the Maginnis galvanized steel flume, sold by the Maginnis Flume Co., Ideal Building, Denver, Colorado; the other known as the Hess flume, sold by the Hess Flume Company, First National Bank Building, Denver, Colorado. The first type of flume has been used in British Columbia. The second type has been developed only recently. The construction is very similar, differing only in the method of forming the interlocking joint. The Maginnis flume has a small channel which fits on the inside of the flume at each joint, while the Hess flume has a bevelled bar which fits in the groove. The Hess flume is made in sizes ranging from a diameter of $15\frac{1}{4}$ inches to 12 feet 9 inches, the Maginnis flume in sizes ranging from 15 inches to 10 feet 2 inches. The capacities given in the catalogues are for the flumes running full with no free board or clearance between the water level and the edges of the sheets. The purchaser should consider this and obtain a flume of ample capacity. The Hess flume has a greater capacity than the same size Maginnis flume because of the form of interlocking joint. The inside channel of the Maginnis flume projects above the inside surface of the metal sheets, while the outside surface of the bevelled bar of the Hess flume is flush with the inside surface of the sheets.

The metal used is either galvanized iron or steel sheets or some metal such as Ingot Iron or Toncan metal. These last two metals are a grade of iron in which all impurities found in ordinary steel or iron have been eliminated as far as possible. The resulting metal has the property of resisting rust or corrosion much better than the common or galvanized iron and steel. The cost of the better grade of metal is not much higher and it should be used in all cases.

As regards economy, the first cost of a metal flume will be higher than that of a wooden flume, but its greater durability as well as its water tightness will make its ultimate cost lower.

PLAIN CONCRETE PIPE NOT REINFORCED.

During the past thirty years cement pipes from 6 to 36 inches in diameter have been used very extensively in southern California where the scarcity and value of water have necessitated its most economical use and have justified the expense of putting in the best form of construction. On many systems the open ditches, especially the laterals, have been entirely replaced by cement pipes. Several hundred miles of cement pipes are now in use and it will not be many years before open ditches will have disappeared with the exception of some of the larger main canals. The advantages which have led to their adoption are:

- 1st. They eliminate the losses of conveyance.
- 2nd. They do not occupy any land which can not be cultivated.

3rd. They do not interfere with traffic and cultivation.

4th. They do not collect the seeds of weeds and distribute them on the irrigated land.

5th. They minimize the cost of maintenance.

Where cement pipes have been found deficient it has almost always been due to defects in the process of manufacturing. The use of cement pipes during the last few years has been extended to other states and there are now many miles of pipe on some of the irrigation systems of eastern Oregon, eastern Washington, and Idaho. During the past two years several miles of pipes have been manufactured by the Fruitlands Irrigation and Power Company, near Kamloops, for use on the distribution lines of the system.

The cement pipe so extensively used in southern California is made in sections two feet long. One end of the pipe tapers in and the other end tapers out so that when two pipes are joined together they form a bevelled lap joint. This form of joint is preferred to bell joint used for sewer pipes because the outside of the pipe is straight and the pipe is easier to lay; it also requires less material to manufacture. The pipe is made by means of metal moulds in which a moist mixture of cement and sand or cement and gravel is very carefully tamped. The mixture is comparatively dry in order that the moulds may be removed to be used again immediately after the tamping is finished. This is necessary to obtain a large output with one set of moulds and as much as 100 feet a day of 30 inch pipe and 500 to 400 feet of 6 to 8 inch pipe are made by experienced pipe men with one set. After the pipe is made it is carefully cured by being kept moist for at least one week and allowed to harden. At the end of a month it is ready to be laid and joined in the trench with cement mortar.

The sizes commonly used are 6, 8 and 10 inches inside diameter for private distributing lines and 10 to 30 or even 36 and 48 inches for the main lines of the irrigation system. The sizes to use in any case depend on the desired carrying capacity and the grade or fall obtainable.

The cement pipe, as manufactured by this dry process, has not the same strength nor is it as impermeable as a pipe made with a wet concrete and can only be used to cross shallow depressions or where the pressure is very moderate. The pressure head which it will safely stand depends on the efficiency of the manufacturer, the mixture used and the diameter of the pipe. The writer recommends the following maximum values as safe for pipes manufactured with care:

Diameter of pipe in inches.	Maximum Pressure Head in Feet.		
	1 to 2 mixture.	1 to 3 mixture.	1 to 4 mixture.
12.....	20	15	12
14.....	20	15	12
16.....	18	14	10
18.....	18	14	10
20.....	16	12	8
24.....	16	10	6
30.....	12	8	6

By using unusual care, experienced pipe men can make pipe which will stand safely 30 per cent. greater heads than those given in the above table.

The use of hand tamped non-reinforced pipe is therefore limited to low pressures and great care must be used in planning and constructing pipe.

lines in order that the safe pressures recommended above be not exceeded and all sudden stresses or pulsations which are likely to occur where air is allowed to accumulate in the pipe line must be prevented by providing ample air vents or air inlets at all summits in the pipe line. These air inlets can be formed by cutting a hole in the pipe and cementing to it a vertical stand pipe made of several sections of cement pipes, the lower end of which is cut to saddle around the hole and the upper end extending above the height to which water will rise.

1.—Manufacturing Hand Tamped Cement Pipes.

Mixtures used.

The best proportion to use depends on the material available. With good clean pit gravel containing about 50 to 60 per cent. sand, less cement can be used than with sand alone. The mixtures commonly used are 1 part of cement to 4 parts of pit gravel and sand for pipes up to 18 inches in diameter, and 1 part of cement to 3 parts of gravel and sand for larger pipes. If crushed rock or screened gravel is used, a good mixture is 1 part of cement to 2 of sand and 3 or 4 of gravel or rock. No gravel or rock larger than one-half the thickness of the pipe should be used. To make the pipe more water tight 5 per cent. of the weight of cement in hydrated lime is added. The sand and gravel must be free from dirt or organic matter.

Mixing materials.

The mixing is very important. It is usually done by hand and in small batches, but for a large plant concrete mixers are advisable. The materials are mixed by means of a hoe or with a shovel; they should be mixed three times dry and three times wet. While it is desirable to use as much water as possible, only sufficient water is added to the mixture to give the consistency of damp earth which will retain its shape when squeezed in the hand. When too much water is added the mix will stick to the mould and the pipe will collapse when the mould is removed. In order to make the ends smoother, some manufacturers use for the ends a finer and richer mixture made of 1 part of cement to $2\frac{1}{2}$ or 3 of screened sand.

Process of moulding. (Figs. 36, 37, 38).

The moulds consist of a set of base rings which are bevelled to form the base of the pipe, an inside core, an outside jacket, a funnelled sheet iron hopper, a rimmer or cast iron ring which fits around the inside core and bevelled on the inside edge, a tamping bar and a feeding scoop. The pipe is usually made on a solid platform or levelled area. To set the mould in position the inside core is placed inside of the base ring and clamped tight to it by turning a lever, the outside jacket is placed around the base ring and contracted by turning a lever. The hopper fits on the top of the outside jacket. The mortar is fed in the moulds and spread in thin layers of one to two inches thick. Each layer must be carefully and uniformly tamped all around the inside core in order that the core be not shifted and the pipe made unequal in thickness. When the last layer has been tamped a little extra material is placed all around the top and the hopper is removed; the rimmer is then placed around the inside core, is jammed down and revolved, at the same time pressing down on the pipe. The inside core is now contracted and removed; the rimmer is taken off. If the pipe has been made on a platform it is now carried by means of lifting hooks with the jacket still clamped on the base ring and placed on level ground. The

jacket is now released and removed and the pipe left on the base ring until it has hardened. For large size pipe to avoid lifting and carrying the pipe, the base rings are placed on the levelled ground instead of on the platform.

Where the pipes have to be used for pressures slightly greater than those given and especially for pipes above 18 inches in diameter, it is advantageous to place in the moulds during the tamping process hoops of ordinary wire about six inches apart. This permits using a slightly wetter mixture and adds strength to the pipe without increasing the cost materially.

Considerable practice is necessary before satisfactory pipe can be made and many pipes will be broken before sufficient experience has been acquired.

Curing the pipe.

When the process of moulding is completed the manufacturing is not finished and the pipe may be ruined if not properly cured. The dry mixture does not contain sufficient water for the cement to crystallize properly and additional water must be supplied by sprinkling during the curing period. The first sprinkling is done with a fine spray as soon as the pipe has set sufficiently to stand it without washing. After this the pipe must be kept continually moist by frequent sprinkling or by covering with wet burlap or sacks for a period of at least one week and not be allowed to dry or become white.

Coating the pipe.

To make the pipe less pervious it is usually coated on the inside with a thin paste of neat cement. Some prefer to use a cement lime mixture made of 2-3 cement and 1-3 lime. The coating of the smaller sizes of pipes, 6 to 12 inches in diameter, is often obtained by dipping the pipe in the liquid. For the larger sizes of pipes the coating is applied with a fiber brush. It is preferable to do this as soon as the pipe will stand the handling, usually when it is 24 hours old, at which time the base rings can be removed. To lift the larger size pipes a lifting jacket which fits around the pipe and tightens when the pipe is lifted, is often used.

Cost of moulds.

There are various makes of moulds, some of which are very cheap. A good mould must be substantially made to withstand the tamping and must be easily and quickly set in position and removed. The largest manufacturer of the moulds used in southern California and supplied to the U. S. Reclamation Service for use on some of its projects is the Kellar and Thomason Company of Los Angeles, California. Their list price in California of a set of moulds for 6 inch pipe with 100 base rings is about \$50; for 12 inch pipe with 100 base rings, \$82.50; for 18 inch pipe with 50 base rings, \$94.25; for 24 inch pipe with 25 base rings, \$107.50; and other sizes in proportion.

Dimensions of cement pipes and rate of manufacturing.

The table given below gives the thickness of the pipe, the number of feet made per barrel of cement, the number of men in one crew of pipe makers, and the number of feet of pipe made per day. The number of men stated is the number required for a large production. The number of feet per day is not the maximum which may be obtained but is an average rate for good experienced men. The 1 to 3 mixture requires about $2\frac{1}{4}$ barrels of cement per cubic yard of concrete. For the 1 to 4 mixture $1\frac{3}{4}$ barrels of cement per cubic yard are required.

Fig. 35.—Steel flume in process of construction, Fruitlands Irrigation and Power Co., Kamloops, B. C.

Fig. 36.—Moulds for casting hand-tamped pipe, showing inside core in position.

Fig. 37.—Process of tamping.

Fig. 39.—Method of laying and joining cement pipe.

**Fig. 40.—Moulds for casting 46-inch reinforced concrete pipe,
Umatilla Project, Oregon.**

Fig. 41.—Process of casting pipe, Umatilla Project, Oregon.

Fig. 42.—Inside core and spiral reinforcement in position for casting 30-inch reinforced concrete pipe, Umatilla Project, Oregon.

Fig. 43.—Placing concrete in moulds, Umatilla Project, Oregon.

Fig. 44.—Reel for making spiral reinforcement, Umatilla Project, Oregon.

Cement Pipe Data.

Inside diameter of pipe in inches	Thickness of pipe in inches	Number of feet of pipe made with 1 barrel of cement		Men composing one crew	Number of feet made per day
		1:4 mixture	1:3 mixture		
6.....	1 1-16	95	75	1 mixer, 1 or	400-500
8.....	1¼	63	50	2 moulders,	350-400
10.....	1½	47	37	1 finisher and	300-400
12.....	1½	36	28	helper.	250-350
14.....	1½	28	22	1 or 2 mixers	225-325
16.....	1¾	23	18	2 moulders	200-275
18.....	1¾	19	15	1 finisher	150-225
20.....	1¾	17	14	and	125-175
22.....	2	15	11¼	helper.	100-150
24.....	2¼	12¼	10½	3 or 4 mixers	100-150
26.....	2¼	11½	9	2 moulders	90-120
30.....	2½	9	7	1 finisher and	90-110
36.....	3	6¼	5	helper.	80

Cost of making pipe.

The table of cost given below is obtained from the above data and for the following prices of labor and material:

Portland cement, \$3.50 delivered on the ground.

Gravel, \$1.00 a cubic yard.

Labor: Tampers \$3.00 a day; mixers and sprinklers, \$2.50 a day.

The figures given include all materials and labor and an allowance of about 10 per cent. for interest and depreciation on plant, administration and supervision, and should not be exceeded with efficient workers.

Cost of Making Cement Pipes (in cents), per Lineal Foot.

Diameter of pipe in inches.	Cost for 1:2 mixture.	Cost for 1:3 mixture.	Cost for 1:4 mixture.
6.....	13 cents	10 cents	7 cents
8.....	15	12	9
10.....	20	15	11
12.....	25	20	15
14.....	30	25	20
16.....	36	30	25
18.....	42	35	30
20.....	50	43	35
24.....	68	60	50
26.....	87	75	63
30.....	95	85	70
36.....	130	115	95

2.—Construction and Laying of Pipe Line.**Excavation of trench.**

The pipe should be laid sufficiently deep below the surface to have an earth covering of at least 12 inches and preferably 18 inches or even more. The bottom of the trench should be graded on an even grade to avoid short siphons which may produce air chambers in the pipe. The width of the trench should be larger than the outside diameter of the pipe by about 12 inches to allow the pipe layers sufficient space to work in. The trench width and depth with the cost of excavation are given in the table below, based on an 18 inch depth of earth covering. The cost of excavation and backfilling is assumed at 20 cents a cubic yard.

Cost of Excavation for Cement Pipe Lines (in cents), per Lineal Foot.

Size of pipe.	Depth of trench.	Width of trench.	Excavation in cubic yds. per lineal foot.	Cost of excavation in cents.
6 inches	26 inches	20 inches	.13	2.6
8	28	22	.16	3.2
10	31	25	.20	4.0
12	33	27	.23	4.6
14	35	29	.27	5.4
16	38	32	.32	6.4
18	40	34	.35	7.0
20	42	36	.38	7.6
24	47	41	.50	10.0
26	49	43	.55	11.0
30	54	48	.66	13.2
36	60	54	.83	16.6

Laying the pipe. (Fig. 39).

The pipes are placed in the trench standing on end with the bell end or grooved end up. To lower the large pipes more easily they may be slid on a chute or skid made of timber. The pipe sections are joined with a mixture of 1 part of cement to 2 of fine sand. The taper end of the pipe which has already been laid, and the bell end of the pipe to which it is to be joined, are brushed clean and well wetted with a fiber brush. About an inch thick of the soil under the bottom of the joint to be made is removed and a trowel full of mortar is spread in its place to form a bed of mortar. The bell end of the pipe which is standing on end is filled with cement mortar and is jammed against the taper end of the previously laid pipe. The mortar which is squeezed out on the inside of the joint is wiped with a wet brush to form a smooth joint. To complete the joint a band of mortar from 2 to 3 inches wide and $\frac{1}{4}$ to $\frac{1}{2}$ inch thick is formed on the outside of the pipe.

It is always preferable to lay the pipe uphill to avoid the shrinkage at the joints due to the pipe pulling away. It is well to protect the bands from the action of the sun for about 30 minutes before backfilling by using wet burlap or placing a board over them. To raise a pipe and hold it on grade do not use clods but shovel in dirt and compact it by tamping. The bands should be wetted before backfilling; this must be done carefully by shoveling the earth, free from rocks, around the pipe and tamping it until the pipe is well covered. With loose sandy soil which packs easily, very little tamping is necessary. The pipe should not be used for at least 2 to 3 days, especially if under pressure, to give sufficient time for the bands to harden.

In the accompanying table is given information regarding the laying and hauling of cement pipe, based on the wages and cost of material given above. Ten per cent. has been allowed for supervision, organization, breaking of pipe and miscellaneous.

Cost of Laying and Hauling Cement Pipe (in cents) per Lineal Foot.

Diameter in inches	Weight of pipe in pounds per foot.	Number of feet laid per bbl. of cement.	Number of men in laying crew.	Number of feet laid per day	Cost of laying exclusive of trenching and hauling, in cents per foot.	Cost per foot of hauling 2 miles.
6	20	500	3	600	2.25	.9
8	32	400	3	600	2.50	1.4
10	42	350	3	500	3.00	1.9
12	56	300	3	450	3.50	2.5
14	69	225	3	400	4.00	3.1
16	85	200	3	300	5.00	3.8
18	100	175	4	300	6.25	4.5
20	110	150	4	300	6.60	5.0
24	160	100	6	300	10.0	7.2
26	175	85	6	250	12.0	7.9
30	220	75	6	200	14.0	9.9
36	320	60	7	200	17.0	14.4

The cost data given in the preceding table are assembled and given below.

Cost of Making, Laying, Trenching and Hauling Cement Pipe (in cents), per Lineal Foot.

Diameter of pipe in inches	Cost of making		Cost of laying.	Cost of trenching	Cost of hauling 2 miles.	Total Cost	
	1:3 pipe	1:4 pipe				1:3 pipe	1:4 pipe
6	10	7	2.25	2.6	.9	15.75	12.75
8	12	9	2.50	3.2	1.4	19.10	16.10
10	15	11	3.00	4.0	1.9	23.90	19.90
12	20	15	3.50	4.6	2.5	30.60	25.60
14	25	20	4.00	5.4	3.1	37.50	32.50
16	30	25	5.00	6.4	3.8	45.20	40.20
18	35	30	6.25	7.0	4.5	52.75	47.75
20	43	35	6.60	7.6	5.0	62.20	54.20
24	60	50	10.0	10.0	7.2	87.20	77.20
26	75	63	12.0	11.0	7.9	105.90	93.90
30	85	70	14.0	13.2	9.9	122.10	107.10
36	115	95	17.0	16.6	14.4	163.0	143.00

These cost values agree quite closely with those given below which are those obtained for about 5 miles of pipe on the irrigation system of the Fruitlands Irrigation and Power Company, near Kamloops. The concrete mixture used was composed of 1 part of cement to 2½ of sand and 1½ of stone, which corresponds to a 1 to 3 mixture of cement and pit gravel. Cement cost \$3 a barrel, sand 75 cents a cubic yard, crushed rock \$2.50 a cubic yard, common labor \$2.50 per day, skilled labor \$3 to \$3.50 per day, and teams \$6 per day. The cost given includes all materials, labor, supervision, and depreciation on plant.

Cost of Making and Laying Concrete Pipe on Irrigation System of Fruitlands Irrigation & Power Co., Near Kamloops.

Diameter of pipe.	Cost of making.	Cost of laying.	Total cost.
8 inches	11.1 cents	.....	.....
10 "	15.7 "	.....	.....
12 "	20. "	11. cents	31. cents
16 "	29.5 "	15.5 "	45 "
20 "	39.5 "	20.3 "	59.8 "
24 "	54.7 "	23.3 "	78 "

3.—Other Methods of Making Cement Pipe.

The lack of uniformity in the pipe made with a dry mixture tamped by hand as described above and the porosity of the pipe, have led to other processes of making pipe, some of which are still in the experimental stage. Two methods have been used, machine tamping and the wet process.

Machine tamped pipe.

Machine tamped pipe is made by a number of plants in the West including one at Peachland. The pipe is made with a comparatively dry mixture much in the same manner as hand made pipe, but the mixture is thoroughly tamped by a mechanical tamper of small cross section which tamps rapidly and gives a high degree of compression. The inside core also rotates during the tamping processes and this gives the inside of the pipe a very smooth surface. The pipe obtained by this process is a very dense pipe. It should be very uniform and superior to the hand made pipe, especially when a pipe is desired for pressure heads greater than the hand made pipe will stand.

The pipe is made with a bell end similar to sewer pipe. This requires more material than the shiplap end obtained with the hand made pipe which increases the cost.

Pipe made by wet process.

To make pipe by the wet process, a wet mixture of cement mortar or cement concrete is poured in the mould and after the mixture has hardened, the moulds are removed. As this takes several hours, only a few pipes can be made per day. For a large output several moulds would be needed and the cost of the plant would be high. However, the moulds need not be as strong as those used for hand tamping and could be obtained at a much smaller cost. The increased cost of plant would be overbalanced, if a large quantity of pipe was made, by the saving in labor and also by the saving in cost of material because a pipe equal in strength and impermeability could be obtained with less cement.

To reduce the number of moulds it has been attempted to accelerate the hardening of the mixture by heating it with steam. This process, however, is still in an experimental stage. The U. S. Department of Agriculture, through its Irrigation Investigations Office, is investigating the wet method of making pipe. The U. S. Reclamation Service has also devised methods of making a wet mixture cement pipe at a reasonable cost for the Tieton irrigation project in Eastern Washington, and for other projects. Their results have not yet been published.

REINFORCED CONCRETE PIPE.

There is a great field for a concrete pipe which will stand moderate pressure and can be manufactured at a cost which will compare well with that of wooden pipe. The hand tamped plain concrete pipe has sufficient strength only for low pressures, and machine tamped pipe or pipe made by the wet process has not been sufficiently tested to know what heads it will stand, though they are probably safe for at least twice the pressure resisted safely by hand made pipe. Reinforced concrete pipe has been used successfully for pressures above 100 feet and is guaranteed by some pipe manufacturers for pressures as large as 150 feet. Reinforced concrete pipe consists of a skeleton of iron or steel imbedded in the concrete shell of the pipe. The reinforcement is made of rods or bars of metals, or some form of expanded metal or wire mesh. For small pipes the circumferential reinforcement is often made as a spiral of wire. For larger pipes the re-

inforcement is bent into hoops by means of rolls and the ends are welded, or overlapped and tied together with wire, or bent to form hooks and a longitudinal rod passed through the eye of the hooks.

The pipes may be made in short sections cast in moulds as the non-reinforced pipe described above, or they may be built continuously in the trench. The latter method has the advantage that it does away with the joints which are usually the point of weakness, but it requires a thicker pipe and is only used for the larger sizes of pipes. For pipes up to 4 or even 5 feet in diameter the first method is generally used and the pipes are cast in sections 3 to 8 feet long. The thickness of the shell seldom exceeds $2\frac{3}{4}$ to $3\frac{1}{4}$ inches. When the reinforcement consists of a spiral, the wire is wound by machinery and kept to the proper spacing by means of longitudinal rods tied to the spiral wire. When hoops are used, they are also tied to the longitudinal reinforcement.

Two companies in the United States make a specialty of the construction of reinforced concrete pipes. One is known as the Meriwether pipe made by the Lock Joint Pipe Co., of New York, with branches at Winnipeg and at Seattle, Washington. The other is made by the Reinforced Concrete Pipe Co., of Los Angeles, California. These manufacturers make pipe up to 72 inches in diameter, from $2\frac{1}{2}$ to 7 inches thick, in sections 3 feet long. On the Umatilla project, in Oregon, several miles of reinforced concrete pipe 30, 46 and 47 inches in diameter have been constructed. The sections were made 4 feet long for the 30 inch pipe and 8 feet long for the larger size. The Roswell park project in Idaho has four miles of reinforced pipe, some of it resisting heads of 70 feet.

1.—Method of Casting Reinforced Concrete Pipe. (Umatilla Project, Oregon.)

The pipes are usually cast in moulds which consist of an inside collapsible core, an outside sectional jacket and a base ring. The process of casting used on the Umatilla project is a good illustration of this form of construction. For the large size pipe cast in sections 8 feet long, the inside core is made of two main pieces of curved steel plate $\frac{1}{8}$ inch thick, held together by a vertical hinge, and a third narrow closing piece or wedge which fits between the other two pieces when the core is set up and is removed when the core is collapsed. The outside jacket is made of twelve curved parts, each 2 feet high and 1-3 of a circumference in length, which when joined in sets of three form a section of the jacket 2 feet high. These parts are made of $\frac{1}{8}$ inch steel plate and to the edges of each part are riveted angles by means of which the parts can be bolted together. The base ring which forms the bell end of the pipe is made of cast iron. (Figs. 40, 41).

To set up the moulds the inside collapsible core is placed in position fitting inside the base ring, and the lowest section of the outside jacket is formed by bolting the three parts around the base ring. The reinforcing skeleton is placed around the inside core, then the concrete, which is a wet mixture of 1 part of cement to 1.8 parts of sand and 3 parts of gravel, is poured between the forms and worked down by means of thin tamping bars. (Fig. 37). The outside jacket is built up in sections, each being filled nearly to the top before the next one is bolted on. To fill the last section a funnel shaped collar is placed around the inside core and bolted to the top of the section. When filled the collar is removed and the upper end of the pipe is finished by hand. The forms are removed 24 hours

after the pipe has been moulded and the pipe is left standing on the base ring for eight days.

For the 30 inch reinforced pipe the forms used are 4 feet long and made of lumber lined with sheet steel (Figs. 42, 43). The interior core consists of two main parts and a wedge or closing piece. The outside form is made of four parts bolted together.

The reinforcement is made of wire wound into spirals 4 feet long by means of a reel on which are hinged spacing bars with notches which give the wire the proper spacing. (Fig. 44). After the wire is wound, longitudinal rods 4 feet long are placed on the outside of the spiral and connected to it by bending the ends over the wires of the spiral at the two ends and by tying them together with wires. The spiral can then be removed from the reel by turning down the hinged spacing bars, and is made more rigid by cross lacing with wire.

2.—Method of Joining.

The pipes, after they have hardened sufficiently, are placed in the trench where they are joined. The best time to lay the pipe is in cold weather, for a rise in temperature will produce expansion and make the joints tighter, while if they are laid in the summer time, any contraction due to lowering of the temperature will tend to produce shrinkage cracks. The joints may be made in three ways: (1) bell and spigot, (2) collar joint, and (3) lock joint.

Bell and spigot joint.

The bell and spigot joint has been used on smaller pipes where the pressure is not great. On the Umatilla project some of the 30 inch pipe has been laid under a pressure head of 23 feet with this type of joint. The pipes are similar to the non-reinforced pipe previously described and have a taper end and a bell end, the joints being made in the same manner as the joints for non-reinforced pipe.

Collar joint.

This joint is used for larger pipes and greater pressures. The joint is made with a reinforced collar from 4 to 8 inches wide, whose inside diameter is slightly larger than the outside of the pipe. The collar, which has been slipped over the pipe last laid, is placed over the joint and the space between the interior of the collar and the outside of the pipe is filled with a rich cement grout poured through two holes in the collar and prevented from running out by means of a mortar paste spread around the edges of the collar.

Lock joint.

The lock joint is intended to make the longitudinal reinforcement continuous. It is used by the Reinforced Concrete Pipe Company and the Lock Joint Pipe Company.

3.—Method of Making and Laying Reinforced Concrete Pipe on Roswell Project, Idaho.

On this project the reinforced pipe was made with the dry mixture hand tamped pipe around which was wound the reinforcing steel wire which was covered with a rich cement mortar. The method of winding the wire, applying the plaster and laying the pipe is described as follows by Zenas N. Vaughan, the engineer in charge:

"Two movable bulkheads, with crank-handles attached, are so arranged that the pipe length can be firmly clamped between them. At a distance back of this device a steel shaft, into which is cut a screw groove, works

freely horizontally. Back of this, and horizontal to it, a wooden shaft is placed for regulating the tension of the wire, and still back of this is a vertical spindle, from which wire unwinds automatically. The wire used for reinforcing is a No. 12 gauge, galvanized wire, having a tensile strength between 500 and 600 pounds. A coil of this is placed vertically upon the spindle, the wire is passed around the tension shaft, thence into the screw groove, and is finally firmly attached to one end of the pipe length by soldering. The pipe is then revolved by two men at the crank handles, by which process the wire is wound upon the pipe under a high tension, the spacing of the laps of the wire being made even by the screw groove. Variation in spacing for different heads is accomplished by using pulleys of different diameters, to govern the rate of revolution of the grooved shaft as compared with that of the pipe length. The reinforcing is stressed the same as that in the main pipe.

When the reinforcing reaches the end of the pipe length, the last two or three laps being made parallel, it is again soldered, and the wire is severed. A steel trowel curved to conform to the shape of the pipe, and suspended above it, is then dropped into place, and then cement mortar $1\frac{1}{2}$ -1, is run upon the pipe as it revolves, the trowel smoothing this down to a uniform thickness. The bulkheads are then unclamped by a lever at one side, the pipe is removed, and is carried away to be properly cured.

"In the trench the bell and spigot ends of the pipe are fitted together, as in the case of sewer pipe. Around the joint is placed a flexible form, made of very heavy canvas, attached to blocks of wood, sawed out in such a way that a space of about one inch measured transversely to the pipe, and six inches longitudinally is left vacant for the reception of the mortar. Along each edge of the form is run a 12-gauge wire, terminating at one end in an iron ring, at the other in a tongue pin, curved in shape, so that when clamped through the ring, it draws the wire to a high tension, firmly binding the form to the pipe. The form is then filled with cement mortar, and immediately afterwards the interior of the joint is carefully pointed to insure water tightness, independently of the collar, as far as practicable. As soon as the collar forms can be removed, the trench is backfilled, to protect the collars while curing."—Journal of Idaho Society of Engineers, pp 40-41, Vol. No. 1.

In southern California reinforced pipe built in the same manner has been used. It is wound with No. 12 galvanized wire spaced about $1\frac{1}{2}$ inches apart and coated over to protect the wire from corrosion. The cost of reinforcing the hand tamped pipe is 10 cents per foot for 10 inch pipe, 15 cents for 12 inch pipe, 25 cents for 20 inch pipe, and 35 cents for 26 inch pipe.

4.—Cost of Making Reinforced Concrete Pipe.

On the Umatilla project in Oregon, a number of reinforced concrete pipe lines 46 and 30 inches in diameter and aggregating several miles in length, have been installed and are entirely successful. These pipes were three inches thick, made as described above. The cost of each is given below. The concrete was composed of 1 part of cement to 2.3 parts of sand and 3 parts of gravel, screened through 1 inch mesh and rejected on $\frac{1}{4}$ inch screen. Cement cost \$2.25 a barrel, sand \$1.00 a cubic yard, gravel \$2.65 a cubic yard. The steel spiral in place cost $5\frac{1}{2}$ cents per pound.

Inside diameter of pipe in inches	Length	Maximum head.	Cost of pipe.	Total cost laid including hauling and trench excavation.	Cost of placing and making joints including material
46.....	9831	110	2.97	4.43	.59
46.....	5312	36	2.24	3.86	.48
46.....	1284	15	2.24	3.26	
30.....	5330	45	1.26	2.25	
30.....	3556	26	1.26	2.45	
30.....	3645	25	1.26	2.04	.22
30.....	1622	18	1.26	1.96	

The Reinforced Concrete Pipe Company of Los Angeles quotes the following approximate prices which include the material, the making and laying but not the excavation of trench and backfilling:

Diameter in inches.	Cost in dollars for		
	25 ft. head.	50 ft. head.	100 ft. head.
24.....	1.75	2.00	2.30
30.....	2.25	2.50	3.00
36.....	2.65	3.10	3.60
42.....	3.20	3.65	4.25
48.....	3.85	4.40	5.10

The prices in southern California for reinforced pipe made with hand tamped pipe wound with wire and plastered with mortar are quoted as follows. These prices are for the pipe laid:

6 inch pipe.....	\$.20 per lineal foot
8 " "	.30 " " "
10 " "	.40 " " "
12 " "	.60 " " "
14 " "	.75 " " "
20 " "	1.20 " " "
26 " "	2.00 " " "

The prices in British Columbia due to higher cost of cement would probably be about 10 per cent. higher.

5.—Advantages and Economy of Reinforced Concrete Pipe.

The great advantage of reinforced pipe is its durability. The first cost as compared to wooden pipe is usually a little greater, but its longer life will make its ultimate cost much lower, especially when the pipe can never be kept constantly full.

It has been shown that for a wooden pipe whose life is 10 to 15 years the total annual cost to pay interest on first cost, renewal and depreciation is 15 per cent. of the first cost, and for a wooden pipe whose life is 20 to 30 years, about 11 per cent. For a concrete pipe, depreciation and renewal are practically eliminated; therefore interest only, at about 6 per cent., need be considered. Based on these figures a concrete pipe would be as economical in cost as a wooden pipe even when the concrete pipe costs about twice as much as the wooden one. The prices of wire wound wooden pipe good for 50 to 100 feet head are about as follows for the Okanagan district:

6 inch pipe.....	\$.28 per lineal foot
8 " "	.38 " " "
10 " "	.52 " " "
12 " "	.57 " " "
14 " "	.64 " " "
16 " "	.80 " " "
18 " "	.95 " " "
20 " "	1.25 " " "
22 " "	1.45 " " "
24 " "	1.60 " " "

The prices for wooden stave pipe for 50 foot head, built in place, are about as follows:

Diameter.	Per lineal foot.
26 inches.....	\$1.80
28 "	2.00
30 "	2.20
42 "	2.80
48 "	3.40
54 "	3.90

Comparing the above prices with those for reinforced concrete pipe it is seen that there is no great difference in first cost, but if ultimate cost is considered, the economy is in favor of reinforced concrete pipe.

However, the use of reinforced concrete pipe is limited to moderate heads, under 100 or 150 feet, and they require careful workmanship and an expensive manufacturing plant. Wooden stave pipes have the advantage that they can be used for higher heads and that they are easily and quickly put together.

With concrete pipes it is very necessary to prevent the accumulation of air in the pipe to avoid water hammer. This requires that air valves of ample capacity be placed wherever air will collect in the pipe.

IV.--DUTY OF WATER AND FACTORS INFLUENCING THE CORRECT USE OF WATER IN IRRIGATION.

DUTY OF WATER.

A knowledge of the quantity of water used in irrigation and of the factors influencing the correct use of water in irrigation is necessary if the best use of the available water supply of British Columbia is to be obtained. The term duty of water is used to express the relation between the area of land served and the quantity of water used. It may be further qualified by using the expressions gross duty, duty measured at heads of laterals, and net duty.

The **gross duty** of water represents the relation between the quantity of water diverted from the source of supply and the total area of land irrigated. It is obtained from measurements of the flow taken at the head of the main canal of the irrigation system and includes besides the quantity applied to the land, all losses and waste in conveyance.

The **duty of water measured at the head of the lateral** is higher than the gross duty because the losses obtained from the head of the main canal to the head of the lateral are not included.

The **net duty** of water represents the water delivered to the field as obtained by measurements taken at the margin of the field. It includes besides the quantities used by the plants, the losses by evaporation, percolation and waste occurring on the field, which can be controlled to a large extent by a skillful irrigator.

The duty of water is spoken of as high when the area irrigated by a certain volume of water is comparatively large, and as low when the area is comparatively small. The gross duty is lower than the net duty, the difference depending on the efficiency of the main canal and distributaries. If all losses of conveyance were eliminated, the gross duty and net duty would be equal. A knowledge of the gross duty is necessary for the engineer to plan the irrigation system in order to make allowances for the conveyance loss. It is also of value in determining the efficiency of a system.

The **net duty** must be distinguished from the **correct amount of water required for maximum production**, for it merely represents the volume of water which is used according to the available water and the judgment and skill of the irrigator. In most cases where water is abundant, the quantity used is in excess of what is actually needed, while where water is very scarce, it may be less than the correct amount. The **correct amount of water to use** is that quantity which is necessary to produce maximum yield

when all the losses of water by percolation, evaporation and waste which can be controlled by ordinary careful methods of irrigation and cultivation, have been eliminated.

The duty of water can be stated in three ways:

1st. In number of acres irrigated by a flow of water of one cubic foot per second for a certain length of time during the irrigation period.

2nd. In number of acres irrigated by one miners' inch for a certain length of time during the irrigation period.

3rd. In number of acre feet per acre which is equivalent to stating the depth of water applied to the land.

The first and second expressions must always include the time in order to specify a given volume of water. For instance a duty of 1 cubic foot per second for 100 acres during the entire irrigation season of 5 months or 150 days would mean 300 acre feet on 100 acres or a depth of 3 feet on the land. If the length of time or period of delivery is only one-half of the irrigation season, the water delivered will give a depth of 18 inches on the land. In the same way a duty of 1 miners' inch to 2 acres during half the time of an irrigation season of five months will give a depth of water on the land of about 5 inches per month or a total depth of 25 inches per season.

The third method of expressing duty avoids any misunderstanding. For instance 2 acre feet per acre means a depth of 2 feet of water on the land. The duty when expressed by either of the first two methods can easily be converted into acre feet or acre inches per acre by the relation previously given which is: One cubic foot per second in 24 hours will give 2 acre feet, or 1 acre inch per hour, and one British Columbia miners' inch in 36 hours will give 1 acre inch. Based on this relation, the following equivalents are obtained.

Depth of Water Applied to the Land in One Month of Continuous Flow.

Rate of flow.	Depth applied.
1 miners' inch to 1 acre, or 1 cubic foot per second to	36 acres.....20 inches
1 miners' inch to 2 acres, or 1 cubic foot per second to	72 acres.....10 "
1 miners' inch to 3 acres, or 1 cubic foot per second to	107 acres..... 6-2-3 "
1 miners' inch to 4 acres, or 1 cubic foot per second to	143 acres..... 5 "
1 miners' inch to 5 acres, or 1 cubic foot per second to	180 acres..... 4 "

1.—Principal Factors Affecting the Net Duty of Water in Irrigation.

The factors which have more or less effect on the duty of water are:

1st. The kind of crops. It is known that some crops require more water than others; for instance, alfalfa requires more water than orchards, and young orchards require less water than full bearing orchards.

2nd. The preparation of land, method of application of water and skill of the irrigator. Poor preparation of the land will cause water to accumulate in the swales and uniform distribution of water is difficult. With furrow irrigation unless great care is taken in the division of water between furrows, there will be a larger amount in some furrows than in others. When the furrows are too long a large excess of water sinks into the soil at the upper ends of the furrows and goes down beyond the plant roots. At the lower ends of the furrows there is often a waste which may cause injury to the neighbors' land or to the road below. If deep furrows are used there is less water and wet soil exposed to the air and less evaporation than with shallow furrows.

3rd. The time and frequency of cultivation. Thorough cultivation as soon as possible after irrigation decreases evaporation losses.

4th. Number of seasons irrigation is practiced. In all irrigated districts it has been the experience that irrigation causes a rise of the water table. If this rise is too great it may submerge the roots and waterlog the soil, but if the water table rises only to a depth where the soil water can be drawn by capillarity to the roots, this will lessen materially the necessary amount of irrigation water.

5th. Climate. Rainfall, temperature, humidity in the air, wind movement, all have an effect. The rainfall and its distribution are important. Abundant rainfall or snow in the winter will be partly stored in the soil and is available to deep rooted plants during the growing season, thus decreasing the necessary irrigation. On the other hand, light showers during the summer may do more harm than good by destroying the soil mulch and increasing soil evaporation. An increase in temperature and in wind movement will increase the soil evaporation.

6th. Character of soil and subsoil drainage. A sandy soil underlaid with a porous subsoil which drains readily will take care of large volumes of water without waterlogging and encourage waste.

7th. The value of water, method of payment for water, judgment of irrigator. A high cost of water leads to higher duty. If water is sold at so much per acre of land independent of the amount of water used, it is human nature for the average irrigator to use all he can. On the other hand, where the water charge is based on the quantity actually used, this leads to careful use and high duty. This factor combined with the judgment or lack of judgment may have more effect on value of the duty of water than all the other factors together.

Because of all the factors on which the duty of water depends, it is to be expected that there is a great difference in the value of the duty of water obtained in different localities or even in the same localities for farms, or orchards under the same conditions but owned by different parties. There are no measurements of the duty of water in British Columbia, but values of the duty of water in the arid states of the United States are very numerous. These measurements have been largely made by the Irrigation Investigations Office of the U. S. Department of Agriculture, usually in cooperation with the state governments. In a review of ten years of irrigation investigations, carried on by the U. S. Department of Agriculture since 1898, Mr. R. P. Teele gives a large number of duty of water measurements which are very instructive. These measurements show that the gross duty ranges from a maximum average of 13.18 acre feet per acre for 7,000 acres of the Modesto system in California, to a minimum of 2.0 acre feet per acre for 5,160 acres irrigated by several small systems in the Santa Ana Valley, of California. The gross duty for 50,000 acres in the Yakima Valley irrigated by several canal systems is 5.70 acre feet per acre. For 20,000 acres of the Bitter Root Valley the average is 4.69 acre feet per acre.

The duty of water is generally lower for a new system, because seepage losses are greater for new canals, new lands require more water, water is more plentiful as only a part of the land is irrigated, and the irrigator is less skillful. As the system gets older, less water is used and the gross duty increases. This is well shown in the following table.

Gross Duty of Water Under Sunnyside Canal, Washington.

Year.	Area irrigated (acres).	Quantity of water per acre, (acre feet).
1898.....	6,883	11.4
1899.....	8,497	10.6
1900.....	10,947	10.2
1901.....	14,964	9.6
1902.....	18,870	9.1
1904.....	32,000	6.0
1909.....	47,000	4.57

This table shows that after 11 years only two-fifths as much water was used as in the first year, or the same amount of water will irrigate $2\frac{1}{2}$ times as much land.

The duty of water measured at the heads of laterals. On new canals the average of measurements made on several canal systems shows that about 50 per cent. of the water diverted is delivered to the laterals. On older canals the percentage is much higher. For the Sunnyside Canal in eastern Washington it was 79 per cent. in 1909.

The net duty of water is the duty as measured at the margin of the fields. This duty is much higher than the gross duty as shown by the table below.

Quantities of Water Delivered to Several Farms Compared With Water Received at head of Main Canal, or Net Duty vs. Gross Duty.

State.	Canal.	Gross duty, or water di- verted by canal. Acre ft. per acre.	Net duty, or water de- livered to farms. Acre ft. per acre.	Per cent.	Remarks.
California....	Gage.....	2.16	1.98	92	Concrete lined canals and pipe systems.
Idaho.....	Ridenbaugh laterals....	4.79	2.50	52	
Washington..	Sunnyside...	9.60	3.96	41	For year 1901.
"	"	4.57	2.79	68	For year 1909.

These measurements show that for the Gage canal system, which consists of a main canal, concrete lined with cement mortar about 1 inch thick, and pipe distributaries, 92 per cent. of the water diverted reaches the land. The measurements for the Sunnyside canal show the increase in efficiency of a system as it gets older. The above results indicate that in a new canal system of unlined earth canals the water delivered to the farms is probably not more than 40 per cent. of the water diverted. For old canals in good condition the efficiency will be increased to 65 or 70 per cent.

2.—Duty of Water for Orchards.

There is relatively little data on the duty of water for deciduous orchards. The data which is of most interest to British Columbia fruit growers is that obtained for the orchards of Washington, Idaho and Montana. Mr. S. O. Jayne, Irrigation Manager in the State of Washington for the U. S. Department of Agriculture, gives the following information:

"The water on a 20 acre apple orchard at Wenatchee was measured during the season of 1908, showing that a depth of 23.04 inches was applied between May 13th and September 23rd. On the same orchard in 1910 27 inches of water were used, the first irrigation was May 30th and the last September 12th. The trees were seven years old in 1908 and bore

a very heavy crop that year, another in 1909 and another last year. The orchard is one of the best cared for as well as one of the best producers of the Wenatchee district. The irrigation was done with more than ordinary care and intelligence. But the soil texture is rather coarse and the water holding capacity low, thus favorable to large percolation losses in the subsoil. Undoubtedly a considerable saving in water would have been possible had the furrows used been only 330 feet long instead of twice that length."

"Another Wenatchee orchard of 50 acres, including apples, peaches and other fruits, used 16 inches in 1908 and 17.5 inches in 1910. The soil here was somewhat heavier than in the former case, but the furrows used were twice as long and besides the run off was considerable. Part of the orchard, however, was not in bearing and none of it so uniformly good as the other example cited. The annual precipitation at Wenatchee is about 6 to 8 inches and comes late in the fall, winter and early spring."

"The records of one of the Spokane valley companies show that on that system a depth of 14.7 inches was applied in 1905, 19.2 inches in 1906, 22.8 inches in 1907 and 17 inches in 1910. The annual precipitation at Spokane is about 18 inches of which less than a fourth occurs during the irrigation season."

In the Bitter Root Valley of Montana, measurements were made on a 40 acre tract of orchard trees. The top soil was a vegetable loam underlaid by a gravel and small cobbles subsoil. In 1900 the 5 year old orchard was irrigated in April, June, July and August. The total depth applied in the four irrigations was about 18 inches and the rainfall during the irrigation season was 1½ inches. In 1901 the 6 year old orchard received four irrigations and the total depth applied was 18.7 inches; the rainfall during the season was 5.9 inches. In 1902 the orchard received 21 inches of irrigation water and the rainfall for the season was 8 inches.

These measurements and others made by the U. S. Department of Agriculture are assembled in the following table.

Net Duty of Water for Orchards.

Locality.	Acreage.	Year.	Duty of water, in acre feet per acre	Remarks.
Wenatchee, Wash.....	20	1908	1.92	Coarse soil.
" "	20	1910	2.25	" "
" "	50	1908	1.33	Medium soil.
" "	50	1910	1.45	" "
Spokane Valley System, Wash ..	..	1905	1.23	
" " " " ..	..	1906	1.60	
" " " " ..	..	1907	1.90	
" " " " ..	..	1910	1.42	
Boise Valley, Idaho.....	1 farm	....	1.48	
Bitter Root Valley, Mont.....	40	1900	1.50	Vegetable loam
" " " "	40	1901	1.56	underlaid with
" " " "	40	1902	1.77	subsoil of gravel and small cobbles.
Average.....			1.62	

This table shows that from 1.23 to 2.25 acre feet per acre were used on these orchards, with an average of 1.62 acre feet per acre or a depth of about 19½ inches. This is equivalent to a net duty of 1 cubic foot per second for 148 acres during an irrigation season of 4 months. Expressed in British Columbia miners' inches, it would be 1 miners' inch to a little over 4 acres.

Professor Fortier, Chief of Irrigation Investigations for the U. S. Department of Agriculture, makes the following statement in Farmers' Bulletin 404, Irrigation of Orchards:

"In general the most water is applied in districts that require the least. Wherever water is cheap and abundant the tendency seems to be to use large quantities, regardless of the requirements of fruit trees. In Wyoming the duty of water is seldom less than at the rate of a cubic foot per second for 70 acres. In parts of southern California the same quantity of water not infrequently serves 400 acres, yet the amount required by the fruit trees of the latter locality is far in excess of the former. In recent years the tendency all over the West is toward a more economical use of water and even in localities where water for irrigation is still reasonably low in price, it is rare that more than $2\frac{1}{2}$ acre feet per acre is applied in a season. This is the duty provided for in the contracts of the Bitter Root Valley Irrigation Company of Montana, which has 40,000 acres of fruit lands under ditch. Since, however, the water user is not entitled to receive more than one-half of an acre foot per acre in any one calendar month, it is only when the growing season is long and dry that he requires the full amount."

"In the vicinity of Boulder, Colorado, the continuous flow of a cubic foot per second for 105 days serves about 112 acres of all kinds of crops. This amount of water if none were lost would cover each acre to a depth of 1.9 feet."

3.—Duty of Water for Alfalfa.

A number of measurements have been made to determine the quantity of water applied on alfalfa fields. In Washington measurements on the Sunnyside project of the Yakima valley gave a net duty in 1909 of 2.79 acre feet per acre. This represents the average for 47,000 acres included in the system, of which about 30,000 acres were in timothy, clover and alfalfa, 10,000 acres in orchard, and the remainder in potatoes. Professor Waller of Pullman, Washington, obtained from measurements made in 1905 on five farms in Washington, aggregating 189 acres, an average net duty of 2.35 acre feet per acre or a total depth of 28.2 inches, the values for the different farms ranging from 21 inches as a minimum to 39.0 inches as a maximum. The average yield was 7.85 tons per acre; the field receiving 39 inches of water gave a yield of 8 tons per acre, and that receiving 21 inches $7\frac{3}{4}$ tons per acre.

In Idaho, measurements made by D. H. Bark in 1910 on five farms in the Big and Little Wood valleys gave the following results:

Net Duty of Water for Alfalfa on Big and Little Wood River Valleys, Idaho.

Locality.	Area (acres).	Kind of soil.	Total depth applied (ft.)	Estimated yield.
Ketchum.....	158.4	Sandy loam, gravelly subsoil.	21.13	3 to $3\frac{1}{2}$
Halley.....	15.2	Gravelly loam, gravelly and sandy subsoil.....	16.00	3 to 4
Gooding.....	51.0	Uniform lava ash soil.....	4.80	4
Gooding.....	31.8	" " " ".....	4.06	4
Gooding.....	69.6	" " " ".....	4.00	4

The large depths of water applied on the farms of Ketchum and Halley are due to the amount of water decreed by court being far in excess of the needs of the land; this leads to wasteful and careless use. These amounts are double or triple the amount used upon similar and more porous soils in the upper Snake River valley. The soil absorbed a large quantity of water but retained only a small part of it, the remainder being lost by percolation.

4.—Duty of Water for Potatoes.

Measurements were made in 1905 on four tracts of potatoes in Washington aggregating 27 acres. A mean depth of 17.6 inches of water was used and the yield was 8.5 tons per acre. Other scattered measurements

made in various states gived uties ranging from 1.00 acre foot per acre in the San Joaquin valley of California, to 7.8 acre feet in Nevada.

The duty of water measurements give above show the usual conditions obtained on an ordinary irrigation system. The large losses in conveyance which occur from the head of the main canal to the point of delivery on the farm, are shown by the large difference between the gross duty and net duty. The values of net duty of water show the variations in the quantities of water applied not only on different crops but also for the same crop under similar conditions. These variations are due not only to local conditions but largely to the skill used by the irrigator in preventing losses of water and to the value of the water. The decrease of the losses or increase in duty as the water becomes more valuable and the irrigators more skillful, is well shown by the measurements obtained on the Sunnyside project in eastern Washington.

FACTORS INFLUENCING THE CORRECT USE OF WATER IN IRRIGATION.

The net duty of water represents the best use of water only when sufficient water is applied to give the best crop production and when the losses of percolation and evaporation are eliminated as much as practicable by skillful application of water and proper cultivation. An intelligent use of water in irrigation requires a careful consideration of the following principles:

- 1st. Disposal of water applied to the soil.
- 2nd. Relation of soil water to soil texture.
- 3rd. Evaporation of soil water and methods of checking it.
- 4th. Percolation of water applied to the soil and percolation losses.

1.—Disposal of Water Applied to the Soil.

The water applied to the soil is disposed of in four ways:

1st. Plant transpiration. A useful part is used to produce plant growth. It passes from the soil into the root hairs, from the root hairs into the stem and is carried to the leaves from where it evaporates. This process is called plant transpiration.

2nd. Soil moisture evaporation. A part is lost by evaporation from the soil. This loss will depend on the texture of the soil, the percentage of moisture in the soil, the method of irrigation, the time and frequency of cultivation, the temperature, the humidity in the air, the amount of wind movement.

3rd. Soil percolation. A part is lost by percolation into the soil beyond the reach of plant roots. This loss depends on the character and quality of soil and subsoil, the depth to the water level, the topography of the land, the skill of the irrigator, the efficiency of the distributing system, the length of the furrows.

4th. Surface waste. A part is lost by the waste of water at the ends of fields or furrows. This water passes to the lower neighbor or on the roads where it may do considerable damage. This loss can be prevented by using care.

2.—Relation of Soil Moisture to Soil Texture.

Water may exist in the soil in three conditions: (1) hygroscopic water, (2) capillary water, and (3) gravity water.

Hygroscopic water is that which occurs in all soils not dried by artificial heating. It is the moisture which a soil dried by artificial heat will absorb from moist air. It exists as a very thin film surrounding each particle but

is distinguished from capillary water in that it does not move by capillary action or otherwise and can not be absorbed by the plant roots in sufficient quantities to be of any practical value to sustain normal plant growth.

Capillary water is that which exists as a thickened film around each soil particle and partially fills the pore spaces. It is held in the soil against gravity and is not drawn out by drainage. It moves in the soil in any direction, and rises in the soil between the soil particles because of the same action which draws the oil up a lamp wick. Capillary water is of greatest importance to plant growth. It covers the plant roots and is the water on which the growth of plants depends.

Capillary water moves from a wet soil to a drier soil and this is what causes the water to spread laterally and to be drawn from the wetter subsoil to the surface where it is evaporated if the evaporation is not checked by a mulch. The water will rise to a greater height in a soil whose texture is fine than in a soil whose texture is coarse, but the rapidity of rise is greater for a soil of coarse texture than for one of fine texture. For instance, Professor Hilgard found that in a sandy soil the maximum height to which water rose was 17 inches in 6 days, while the maximum height for a clay soil was 46 inches in 195 days. In the sandy soil it took 1 hour to rise 8 inches while in the clay soil it took 12 hours to rise the same height.

Gravity water is that water which moves downwards through the soil pores because of gravity. When the soil is saturated the pores are entirely filled with water and that water which fills the space between the pores not occupied by capillary water, is gravity water. Gravity water is not retained by the soil if there is natural or artificial drainage. It passes downwards and supplies capillary water to the soil below and the excess reaches the water table or a drainage channel. When there is an excess of gravity water, it passes down to a depth which is too far below the ends of the plant to be drawn up by capillarity and is wasted.

A soil which is saturated contains gravity, capillary and hygroscopic water. A soil which is drained contains capillary and hygroscopic moisture only. A soil which is air dried in the sun contains hygroscopic moisture only and a soil which is dried by artificial heat contains no moisture.

Percentage of free moisture in soil for plant growth.

The pores for most cultivated soils will average from 25 to 50 per cent. by volume of the entire volume, being smallest for sandy soils and greatest for clay soils. For plants to grow it is necessary that they have air as well as water and for best growing condition it has been found that the capillary water in the soil should range from 40 to 60 per cent. of the pore space. This leaves about an equal space for air. In other words, for maximum growing condition a very sandy soil containing 25 per cent. pore space should have 10 to 15 per cent. by volume of free moisture, while a heavy clay soil containing 40 to 60 per cent. pore space should have 20 to 30 per cent. by volume of free moisture. Expressed in per cent. by weight, for a very sandy soil air dried weighing 110 pounds per cubic foot, the free moisture content should be from 5.7 to 8.5 per cent.; for a stiff clay soil weighing 75 pounds the moisture content should be 16.6 to 25 per cent. and for an average sandy orchard loam, 10 to 15 per cent. Professor Loughridge found that on a sandy soil where the moisture content in the fourth foot of the soil was 15 per cent. by weight, there was an excess of moisture which crowded out the air and caused the trees to suffer. In this case the correct moisture content should have been about half of the pore space or about 10 per cent. by weight.

The minimum amount of free soil moisture in four feet of soil necessary to keep trees in good growing condition has been found to be from 2.5 to 3 per cent. for apples and prunes, 3 to 4 per cent. for pears, and 1 per cent. or even less for apricots and peaches. The irrigator may use these above relations to determine by experiment if his soil has sufficient moisture. The procedure would be to take samples from the soil around the roots and determine the percentage of moisture. This is done as follows: By means of a soil auger take soil samples of each foot of soil beginning with the top soil where the roots begin, which may be 6 inches or more from the surface, down to the depth to which they extend, which may be four or five feet or more. The samples should be immediately placed in a jar to prevent evaporation. A very suitable jar is a glass fruit jar which can be closed air tight. The percentage of moisture is determined by weighing out 100 ounces of the sample before losing any moisture; then spread the sample thinly over a tin plate and expose it to the sun for the greater part of a day or until thoroughly air dried. If the weight is now 90 ounces there was 1 ounce of free water for every 10 ounces of moist soil, which is sufficient for good growing condition. If the weight air-dried had been 97 per cent. it would show that there was only 3 per cent. free moisture and that irrigation was necessary.

Professor Loughridge found from determination of soil moisture in southern California citrus orchards (Bulletin 203, Office of Experiment Stations, U. S. Department of Agriculture) that the percentage of soil moisture for a sandy loam averaged about 4.68 per cent. for the upper 4 feet and 5.76 per cent. for the upper 13 feet before irrigation and immediately after irrigation the percentage in the upper four feet averaged about 9.64 per cent. Six weeks after irrigation the amount of moisture was a little greater than previous to the application of water. About one-fifth of the water applied was retained, the other four-fifths had been taken up by soil evaporation and plant transpiration. For a clay loam soil the percentage of moisture averaged for 5 feet depth of soil, 6.81 before irrigation, 11.27 immediately after irrigation, and one month after irrigation the moisture percentage almost returned to its normal amount before irrigation. On a heavy loam the percentage of free moisture was 5.47 before irrigation and 10.86 immediately after irrigation.

3.—Evaporation of Soil Water and Methods of Checking It.

The effects of the various factors influencing soil water evaporation have been investigated through very interesting experiments made in the arid region by the Irrigation Investigations Office of the U. S. Department of Agriculture, the Agricultural College of Utah, and others. The results were obtained by means of tanks or pots filled with soil and placed as nearly as possible under actual field conditions for irrigation and cultivation. The water applied was measured in each case and loss from evaporation was obtained by weighing the tanks at desired intervals. The results obtained have appeared in the following bulletins: U. S. Department of Agriculture, Office of Experiment Stations, Bulletin 177; Utah Agricultural College, Bulletins 80, 86, 104, 105. While these investigations have been carried on for some time, the results so far published are not sufficient to justify definite conclusions, but the work is being continued and with the additional information very valuable and practical results will be obtained.

Fig. 45.—Evaporation during a period of 33 days from soil irrigated 6 inches deep, Davis, Cal.

Fig. 46.—Effect of mulches on evaporation from soil, Davis, Cal.

Fig. 47.—Effect of mulches on evaporation from soil, Wenatchee, Wash.

The results already obtained by experiment are of great value in indicating how some of the factors on which the use of water depend can be controlled by the irrigator. These results may be summarized as follows:

Extent of exaporation from bare soils not cultivated.

On four California orchard soils an average of $12\frac{1}{4}$ inches of irrigation water was applied and the evaporation loss per season (Feb. 23rd to August 31st) was 94 per cent. This shows the large percentage of loss in soil moisture which may obtain during a long season. The rate of evaporation depends much on the moisture in the soil. The results obtained on a sandy orchard loam in southern California are as follows:

For a sandy loam saturated.....weekly evaporation was 4.75 in. water
 For a sandy loam with 17.5% free water....weekly evaporation was 1.33 in. water
 For a sandy loam with 11.9% free water....weekly evaporation was 1.13 in. water
 For a sandy loam with 8.9% free water....weekly evaporation was .88 in. water
 For a sandy loam with 4.8% free water....weekly evaporation was .25 in. water

The large rate of evaporation from soils which are very wet indicates the necessity for wetting as little of the surface as possible when irrigating. With orchards this may be obtained by using deep furrows.

The rate of evaporation for a period of 33 days following an irrigation 6 inches in depth is illustrated in the diagram given below for a California brown loam soil not cultivated after irrigation (Fig. 45). This diagram shows the excessive rate of evaporation immediately after irrigation when the surface soil is very wet. The loss during the first three days was 17 per cent. of the water used and is about equal to one-half of the total loss during the 32 days which is 35 per cent. These results indicate the importance of preventing the evaporation loss as early as possible after irrigation.

Effect of Depth of Furrows on Evaporation from Soil.

Fig. 48.

Effect of soil mulches on soil evaporation.

The effect of dry soil mulches of different thickness applied on the soil surface after irrigation are shown in the diagrams given below. The first one (Fig 46) is for the California soil whose daily rate of evaporation is given above. The second one (Fig. 47) is for a Wenatchee orchard sandy loam soil typical of the orchard lands of the north central portion of the State of Washington. These diagrams show the effectiveness of different depths of mulches. A 9 inch mulch practically stopped all evaporation.

These experiments represent theoretical conditions which can not be obtained in the field. It is, however, possible to approach these conditions by producing a mulch by cultivation. Conditions more nearly like field conditions were followed in another experiment made in California on a sandy loam soil. In this experiment 8 inches of water was applied to the soil surface in a furrow 4 inches deep. The water was applied during the first two days and at the end of the third day some of the tanks were cultivated 6 inches deep, the others receiving no cultivation. The evaporation loss during the first three days was 10.5 per cent. or .84 inch, during the next three days it was 1.2 per cent. from the cultivated tanks and 3.6 per cent. from uncultivated tanks, showing that the loss from cultivated soil was one-third that from uncultivated soil.

Effect of depth of furrows on soil evaporation.

The experiments made on California orchard soil imitated as much as possible actual field practice. A depth of $5\frac{1}{4}$ inches of water was applied to different pots, on the surface and in furrows 3, 6, and 9 inches deep. The irrigation lasted two days and the soil was cultivated at the end of the third day. The evaporation losses for the first three days and for the next seven days following cultivation were as shown in the accompanying diagram. The loss for furrows 12 inches deep was $\frac{1}{2}$ of the loss obtained with surface irrigation.

4.—Percolation of Water Applied to the Soil.

To obtain maximum benefits from irrigation water the water applied should be uniformly distributed throughout the soil down to the lower end of the roots and any water which passes beyond the capillary reach of the lower ends of roots is wasted. It flows underground either into some drainage channel or may cause considerable damage by the waterlogging and the rise of alkali in the lands below. In actual practice it is impossible to obtain perfect distribution of water and have no waste, but by careful irrigation it is possible to minimize the loss by percolation.

Effect of texture of soil and subsoil on percolation.

When water is applied in irrigation, the soil directly in contact with the water is saturated, a portion of this water moves downwards and wets the soil beneath furnishing capillary water or free moisture to the roots below. If sufficient water has been added, the excess water passes into some drainage channels or down to the level of standing water. This excess water is wasted. This loss by percolation is usually greater in open soils well drained through which gravity water percolates readily and it is very easy for a careless and wasteful irrigator to use a great deal more water than necessary. Some of the waste can not be eliminated because when a soil is irrigated by furrows the upper end of the furrows where the water is turned in receives an excess of water. In some southern California orchards with careful irrigation, it has been found that the water at the upper

end of the furrows percolated to depths as great as 30 feet. Where irrigation is practiced less carefully the waste is no doubt still greater. Mr. D. H. Bark, in charge of Irrigation Investigations in Idaho, states that sometimes on porous soils where the water is run long distances, as high as 95 per cent. of the water percolates so deep on the upper one-third of the field that it passes beyond the zone of the roots and is lost. The waste can be minimized by using short furrows.

Sandy soil underlaid with gravel is the most difficult to handle to prevent percolation losses but they may be made small by using frequent irrigation applied in light quantities instead of heavy irrigations, a part of which is wasted, and by laying out the distribution system so that the water does not have to travel long distances in the furrows or over the fields.

Percolation of water applied in furrows.

It is important that the irrigator should know how the water applied to orchards in furrows distributes itself within the soil, in order that he may know how far apart the furrows should be, how long they should be and the length of time water should be run in the furrows. The correct practice will vary with the different types of soils and each irrigator should become acquainted with his soil by observing the motion of the water in the soil by means of borings made with a soil auger and trenches dug across the furrows.

Very interesting experiments were made in southern California citrus orchards by Professor Loughridge for the Irrigation Investigations Office of the U. S. Department of Agriculture (Bulletin 203, Office of Experiment Stations). Cross trenches were dug across several furrows to a depth of 5 or 6 feet, the furrows were extended over the trench by short wooden troughs. At regular periods during irrigation a thin slice of soil was cut from the face of the trench exposing a fresh surface of the wet area. The outlines were measured and recorded during and after the period of irrigation. The accompanying diagrams give the percentage of free moisture in the soil and show by irregular curves the depth of percolation at different times.

Fig. 49.—Outlines of percolation under sixteen furrows in sandy loam.

(O. E. S. Bulletin 103, U. S. Department of Agriculture.)

The first diagram (Fig. 49) is for a sandy loam soil, 7 to 9 feet deep underlaid with a sandy soil. The observations were made in a trench excavated across sixteen furrows. The furrows were 660 feet long and the trench was half way down the furrows; it required about five hours for the water to travel half the length of the furrows and about 12 hours more to reach the end. This diagram shows results which are very surprising to the irrigator. It is commonly believed that the water spreads laterally so as to give a fairly uniform distribution throughout the soil, but the diagram shows that the water spreads only a small distance laterally, usually less than 3 feet from the furrows, which is not sufficient to wet the soil uniformly. In the first foot 77 per cent. of the soil was wetted, in the second foot 78.75 per cent., in the third foot 71.13 per cent., in the fourth foot 40 per cent., in the fifth 27.50 per cent., and in the sixth 5 per cent. This shows the necessity for placing the furrows close to the trees and for having sufficient number of furrows to bring them close together.

The next diagram (Fig. 50) is for a gritty clay loam with a subsoil which is very compact, but which quickly absorbs water and becomes soft. The trench was made across five furrows half way down the furrows. At the end of 54 hours the water was cut off. The distribution of water in this soil was much more uniform than in the previous case. This is due to the soil being more compact which produces a slower downward percolation and a greater sideways motion because of the greater effect of capillarity.

The third and fourth diagrams (Figs. 51, 52) show the limit of percolation in a sandy soil from single furrows 10 inches deep and 5 inches deep for a period of seven hours. With the deep furrow there is a greater depth of percolation and the water spreads farther sideways. The deep furrow also has the advantage that less of the surface mulch is wetted than with shallow furrows.

The fifth and sixth diagrams (Figs. 53, 54) show the outlines of percolation in heavy loam for four deep and four shallow furrows under the same conditions of soil and water. The deep furrow gives a more uniform distribution of water, a greater depth of percolation, a greater sideways absorption, and a smaller percentage of moisture rises by capillarity to the surface to be lost by evaporation.

The seventh diagram (Fig. 55) shows the probable distribution of moisture in a sandy loam lengthwise with the furrows, from the head to the foot of the furrows as determined by a few borings. The furrows are 660 feet long and the water was run in them for a period of three days. Sufficient borings were not taken to determine the curve accurately. Other experiments showed that the curve may ascend quite abruptly toward the surface as indicated by the dotted line. This diagram shows clearly that the water is not evenly distributed; the depth of percolation near the head ditch is much greater than the average depth of percolation along the furrow; a large part of the water passes beyond the reach of plant roots and is wasted. With heavy soils the difference in percolation would not be so great. This experiment shows the necessity for short furrows, especially in sandy soils.

Fig. 50.—Outlines of percolation under five furrows in gritty clay loam.

(O. E. S. Bulletin 203, U. S. Department of Agriculture.)

Fig. 51.—Outline of percolation in sandy soil from furrow 10 inches deep in seven hours.

(O. E. S. Bulletin 203, U. S. Dept. Agr.)

Fig. 52.—Outline of percolation in sandy soil from furrow 5 inches deep in seven hours.

(O. E. S. Bulletin 203, U. S. Dept. Agr.)

Fig. 53.—Outlines of percolation under four deep furrows in heavy loam.
(O. E. S. Bulletin 203, U. S. Dept. Agr.)

Fig. 54.—Outlines of percolation under four shallow furrows in heavy loam.
(O. E. S. Bulletin 203, U. S. Dept. Agr.)

Fig. 55.—Curve showing probable lower limit of percolation from head to foot of furrows in sandy loam.
(O. E. S. Bulletin 203, U. S. Dept. Agr.)

V.—IRRIGATION AND CULTIVATION OF ORCHARDS.

DISTRIBUTION OF WATER.

For the orchards of British Columbia, as well as for other field crops, with the exception of some level lands devoted to growing hay, furrow irrigation is the only feasible method.

The success in obtaining uniform distribution of water by furrow irrigation depends largely on the method used to divide the water equally between the furrows. The earliest method of carrying the water to the head of the furrows is by means of the earthen head ditch located along the upper boundary of the orchard at the upper end of the furrows. The division of the water is effected by cuts made in the side of the earth ditch. This method is still used by many, but because crude and unsatisfactory, it has led some orchardists to adopt improved methods of division such as lath tubes or iron spouts placed in the ditch bank, while some of the best

orchardists have replaced the earth ditch by wooden flumes or the more permanent concrete flume or concrete pipe distributing system.

Where the orchard is small and the slope regular, one head ditch or head flume carrying the water from the point of delivery and placed on the highest part of the land to be irrigated, may be all that is necessary. But for larger orchards and for irregular slopes, it is necessary to have two or more head ditches or flumes to which the water is carried by a supply ditch, pipe, or flume. In laying out such a distribution system the irrigator should study the topography of the land and subdivide his orchard with sufficient head ditches to give furrows which are not too long and too steep. Usually it is desirable to make the furrows not over 600 for ordinary sandy loam and 300 feet for more porous sandy soil.

Fig. 56.—Typical forms of earth ditches.

1.—Earthen Head Ditch.

The head ditch is placed along the highest boundary of the orchard or if there is a ridge through the center of the orchard, it is placed on this ridge and supplies the furrows running down the slope on both sides. The proper grade depends on the volume of water to be carried and on the character of the soil; the velocity must not be too great or it will erode the soil. On the other hand it is best to have sufficient velocity to prevent the growth of water plants. Velocities of 2 to $2\frac{1}{2}$ feet per second are desirable. The diagram (Fig. 56) and accompanying table to which has been added the last column, are taken from Bulletin No. 4: Guide to Irrigation Practice on the Pacific Coast, by S. Fortier, issued by the Publicity Committee of the Fifteenth National Irrigation Congress.

**Table Giving the Mean Velocity and Discharge of Ditches With Different Grades.
Farm Ditch No. 1.**

Inches per rod.	Grade.		Mean velocity in feet per second.	Discharge.		
	Feet per 100 feet.	Feet per mile.		Cubic feet per second.	British lumbia miners' ins.	Co- ins.
$\frac{1}{2}$	.25	13.33	1.01	.67		24
$\frac{3}{4}$	.38	20.00	1.23	.81		29
1	.51	26.67	1.42	.93		33
$1\frac{1}{4}$	.63	33.33	1.59	1.05		37
$1\frac{1}{2}$	.76	40.00	1.75	1.16		41
2	1.01	53.33	2.04	1.35		48
$2\frac{1}{2}$	1.26	66.67	2.28	1.50		53
3	1.51	80.00	2.50	1.64		58
$3\frac{1}{2}$	1.77	93.33	2.70	1.78		63

Farm Ditch No. 2.

$\frac{1}{4}$	.13	6.67	.82	.80		28
$\frac{1}{2}$	.25	13.33	1.16	1.00		36
$\frac{3}{4}$	.38	20.00	1.42	1.30		46
1	.51	26.67	1.64	1.50		53
$1\frac{1}{4}$	.63	33.33	1.84	1.70		60
$1\frac{1}{2}$	.76	40.00	2.02	1.80		64
$1\frac{3}{4}$	.88	46.67	2.18	2.00		71
2	1.01	53.33	2.34	2.10		75
$2\frac{1}{2}$	1.26	66.67	2.61	2.40		85

Farm Ditch No. 3.

$\frac{1}{8}$	.06	3.33	.79	2.08		74
$\frac{1}{4}$	.13	6.67	1.13	3.00		106
$\frac{1}{2}$	.25	13.33	1.60	4.20		150
$\frac{3}{4}$	.38	20.00	1.97	5.20		185
1	.51	26.67	2.28	6.00		213
$1\frac{1}{4}$	.63	33.33	2.57	6.80		242

Farm Ditch No. 4.

1-16	.03	1.58	.84	4.20		150
$\frac{1}{8}$	.06	3.33	1.08	5.40		192
$\frac{1}{4}$	.13	6.67	1.54	7.70		274
$\frac{3}{8}$	.19	10.00	1.89	9.50		338
$\frac{1}{2}$	.25	13.33	2.20	11.00		390
$\frac{5}{8}$	.31	16.67	2.45	12.20		434
$\frac{3}{4}$	.38	20.00	2.69	13.40		475

Ditches of the above forms can be made by first plowing four furrows and then removing the loose earth either with shovels or a narrow scraper, or the loose soil may be thrown up on the sides by using a V scraper or crowder as illustrated below (Fig. 57, 58).

To turn the water into the furrows the water is checked and the water surface raised by placing in the ditch dams of canvas or metal tappoons, or by making dams of earth or manure. When the ditch is permanent a wooden or concrete check gate can be placed in the canal. The greatest difficulty in irrigating from an earthen head ditch is the care necessary to give a satisfactory division of the water in the furrows. A skilled irrigator may adjust the size and depth of openings made in the ditch bank so as to secure a fairly uniform flow in the furrows, but it requires attention to prevent the washing of the soil at some of the openings which will cause greater discharges through these openings and lower the water level in the ditch so that other furrows receive little or no water. To prevent

Fig. 59.—Lath tube.

Fig. 60.—Method of placing lath tube in ditch bank for furrow irrigation.
(Farmers' Bulletin 373, U. S. Dept. Agr.)

Fig. 63.—Concrete distributing flume.

this some use pieces of sacks or canvas, others use pieces of shingles or small rocks, etc. A better improvement is the use of short tubes placed in the bank of the head ditch. These tubes may be made of laths nailed together and cut in two foot lengths or may be pieces of discarded pipes $\frac{1}{2}$ inch to 2 inches in diameter. A lath tube having an inside opening 1 inch square placed 8 inches below the water level will give a discharge of 1 miners' inch. The flow through the tube can be regulated by a slide. The surface of the water can be kept at the proper height by means of check gates regulated by flashboards and spaced according to the grade of the ditch. The accompanying sketches show the lath tube and the manner of placing them, and also the check gates in the ditch bank. (Figs. 59, 60).

2.—Wooden Head Flumes.

Wooden flumes with small openings in one side give more accurate division of the water and are used very extensively in Eastern Washington. They can also be elevated above the ground to carry water over shallow depressions which is an advantage over earthen ditches. However, the height above the ground must not be over two or three feet or the water falling through the opening into the furrows will cause excessive washing. The flumes usually vary in width from 8 to 12 inches and from 6 to 10 inches in height, and the openings are controlled by metal or wooden slides.

3.—Concrete Head Flumes. (Figs. 61, 62).

The short life of wooden flumes has led most of the orchardists of southern California to use either concrete flumes or cement pipes. A concrete head flume is made of the same form as the wooden flume and galvanized iron spouts or tubes from $\frac{3}{4}$ to $1\frac{1}{2}$ inch in diameter are inserted in the side of the flume before the concrete has hardened, there being one spout for each furrow (Fig. 63). On steep slopes where the velocity is high, to give an even distribution through the spouts, checks made of short pieces of lath are inserted below each opening as shown in the accompanying sketch. To hold the checks in place, one end of the lath fits into a groove cut in the side of the flume by means of a trowel before the concrete is hard.

The thickness of the floor for all sizes up to 24 inches in width is 2 inches. The side walls for all depths up to 12 inches are $2\frac{1}{2}$ inches thick at the top and 3 inches at the bottom. The flumes are made almost any size. The dimensions and cost of some of the sizes commonly used in southern California are as follows:

Bottom width. inches.	Depth. Inches.	Cubic feet of concrete per lineal foot of flume.	Cost per lineal foot in cents.
8	11	.54	20
9	12	.60	22
10	12	.63	24
10	14	.66	25
10	16	.69	26
10	18	.71	27
10	20	.74	28
10	22	.77	28½
10	24	.80	29
12	12	.71	25
12	14	.74	26
12	16	.76	27
12	18	.79	28
12	20	.82	29
12	22	.85	29½
12	24	.88	30

The cost of labor and materials for which the above costs were obtained are: Labor \$2.00 to \$2.50 for 9 hours, cement \$3.50 a barrel, and gravel \$1.50 a cubic yard.

FIG. 64.—Forms for construction of concrete flumes.

The flumes are constructed on the ground by using a set of forms or moulds into which the concrete is placed (Fig. 64). The moulds consist of an inside bottomless trough similar to the form used for lining ditches, but made with the same dimensions as the inside of the flume, and outside walls or sheathing held the proper distance apart from the inside form by means of spacing blocks and heavy U shaped iron, straddling over the outside wall and inside wall. Instead of the U shaped iron, the outside walls could be held in place by stakes driven in the ground. To build the floor and sides at the same time the inside walls are held above the ground by the spacing frames a height equal to the thickness of the floor. The flume is built in sections 12 feet long, which is the length of the forms. No provision is made for contraction and small shrinkage cracks occur. These could be eliminated by inserting at the edges a metal tongue 2 or 3 inches wide imbedded about halfway into each section. This tongue should be well painted with oil or soap to prevent the adhesion of the concrete and it will then act as a tongue and groove joint.

To permit the quick removal of the forms, which is necessary unless sufficient forms are used to build a considerable length at one setting, the concrete is mixed comparatively dry and requires careful tamping. A mixture of 1 part of cement to 5 of well graded pit gravel is generally used. It is important that the concrete be kept moist by sprinkling or otherwise for a period of at least one week. When completed the side walls are partly backfilled with earth up to about one-half of their height. It is better to have the spouts at least 4 inches long and preferably six to prevent the washing away, by the action of the water coming out of the spout, of the soil from under the flume, which will cause it to settle and crack. These galvanized iron spouts are made by local metal workers at a cost of $4\frac{3}{4}$ to $5\frac{1}{4}$ cents each.

4.—Cement Pipes and Distributing Stand Pipes. (Figs. 65. 66).

In southern California many hundreds of miles of cement pipes have been used for the distribution of water to orchards and in recent years its use has been extended to some of the orchards in Washington and Idaho. While many orchardists in southern California still prefer the open flume, there are the following objections to open flume:

1st. Teams and farm implements can not cross the flume and there is always a strip of land on each side that can only be partially cultivated because it can not be crossed in the opposite direction.

2nd. The flume is liable to be damaged by the teams and farm implements.

3rd. The flume may settle and crack if the earth underneath is washed away by the water passing through the spouts into the furrows.

4th. The furrows can only be made with teams and cultivators up to 15 feet from the flume and they must be completed by hand.

5th. Leaves may fall in the flume and stop up either partially or completely the openings of the distributing spouts, which requires extra time on the part of the irrigator.

These disadvantages have led many of the orchardists to the use of underground pipes which do not interfere with cultivation.

A complete underground pipe distributing system consists of:

1st. A main pipe line which carries the water from the measuring box or point of delivery to the lines of distributing stands which take the place of head ditches.

2nd. The distributing lines which conduct the water from the main pipe line, and which are connected to the distributing stands.

3rd. The distributing stands or basins by means of which the water is brought to the surface and distributed into the furrows through small galvanized iron spouts inserted in the sides of the basin.

4th. Regulating boxes and accessories.

A typical system is shown in the accompanying sketch (Fig. 67). The pipe lines are made of hand tamped pipe placed in trenches of such depth that there is at least one foot of earth covering. The method of making the pipe sections and joining them, as well as the properties of the pipe and the cost of making and laying have been fully described (pages 47 to 57.) The main pipe line or feed line is not necessary where only one line of stands is necessary, such as where the orchard is small and can be irrigated with one set of furrows 330 or 660 feet long. But for larger orchards it is desirable that the orchard be supplied by two or more head ditches or distributing pipe lines in order to limit the length of the furrows to not over 660 feet and preferably 330 feet for sandy soil. The main supply pipe feeds the distributing lines and conducts the water from the measuring box or point of delivery to the head of the line of stands. At the junction of the line of stands with the main pipe, turnout boxes with suitable gates are necessary to control the flow into each line. The lines of distributing stands extend across the direction of the furrows. At the head of each tree row and in line with the trees a stand is connected to the distributing line.

There are various ways of making the stands and of regulating the flow. They vary only in details and can be classified into two distinct systems, one known as the overflow system, and the other, the pressure system.

The overflow system is best adapted where the line of stands is placed on a flat uniform grade. The pressure system is best where the slope of the ground is steep and not uniform. These two systems are illustrated in the accompanying diagram (Fig. 68). With the overflow system the lines of stands must usually be divided by means of overflow boxes or pressure regulating boxes into a number of sections depending on the grade, and each section includes a number of distributing stands, the tops of which are placed at the same level. The overflow box acts as a check in a head ditch and by closing or regulating the gate of the overflow it causes the water to rise in the distributing stand and maintains the water surface in the stands at about a uniform level. If the gate of the overflow box is closed the water which is not distributed through the stands above it, passes over the overflow to supply the stands below; this makes the system practically automatic. The distributing stands are seldom made higher than 16 inches above the ground; when it exceeds this a new section or group of stands is made by inserting another overflow box. On steep grade the cost is much increased because of the great number of overflows.

The pressure system, or valve system, is so called because the distributing line is divided into a number of sections, depending on the grade, so that each section is under a water pressure which the pipe will safely stand. Because of the pressure it is necessary to regulate the flow into each basin by means of a valve. Usually the sections should not be longer than 600 feet and the pressure head should not exceed 15 feet. The boxes which divide the line in sections control the pressure by means of a gate.

The diagram shows the position of this gate which is placed on the upstream or inlet side of the box. The pressure of the water tends to push the gate away from the gate frame and cause leakage. To prevent this the gates, which are named pressure gates to distinguish them from the cheaper slide gates, are so designed that when the gate is closed turning the handle brings the gate tight against its frame. This is obtained through some

Fig 67 Cement Pipe system of distribution of water for Orchard furrow irrigation.

Fig. 57.—Adjustable V crowder.

Fig. 58.—Using adjustable V crowder.

Fig. 61.—Distribution of water in furrows from concrete head flume.

Fig. 62.—Concrete distributing flume connected to weir take out box.

Fig. 65.—Distribution of water in furrows from stand pipe.

Fig. 66.—Line of distributing stand pipes for distribution of water from cement pipe.

Fig. 69.—Construction of distributing stand pipes.

Fig. 70.—Distributing pressure stand pipe, type D.

Fig. 71.—Applying water in deep furrows.

Fig. 72.—Making deep furrows with plows attached to wheeled cultivator.

Fig. 74.—Applying water in zigzag furrows.

OVERFLOW SYSTEM.

PRESSURE SYSTEM.

DETAILS OF DISTRIBUTING STANDS.

DETAILS OF OVERFLOW STAND.

Fig. 63.—Details of cement pipe distributing lines.

mechanical device which varies in construction with the different manufacturers. Instead of using pressure gates, the ordinary slide gate can be used by placing it on the downstream side or outlet to the box, but in this case the box must be built so that its top is higher than the highest distributing stand of the section. This may require a height of 10 or 15 feet above the ground, which is objectionable. The pressure system can be used where the distributing line has to cross shallow depressions. In all cases the line must be divided into sections so that the maximum head will not exceed 15 feet.

Details of stands.

The stands are shown in detail in the accompanying diagram. Stand A, used for the overflow system, consists of a section of 6 or 8 inch pipe placed vertically with the lower end cut to saddle over a 6 or 8 inch hole made in the pipe line by means of a sharp pick. The joint is made with a rich cement mortar mixed in the proportion of 1 part of cement to 2 of sand. Around the upper end of the pipe, at the surface of the ground, is placed the distributing basin and the space in the basin around the smaller pipe is filled with cement mortar. The basin is usually a section 6 to 18 inches long of 16 inch pipe. Around the circumference of the basin, near the floor, from 4 to 6 distributing gates or spouts are inserted and cemented in holes cut as soon as the basin has been made or cast in the basin when making it in the metal moulds.

Stand B is also used for the overflow system and consists of a single length of pipe 8 to 12 inches in diameter in which the spouts are inserted. (Fig. 69). The larger basins of the type A are preferable where the furrows tend to wash together.

Stands C and D are used for the pressure system. They are made as stands A and B with the addition of the regulating valve cemented in the upright pipe (Fig. 70). Stand E. can be used also for the pressure system. It is similar to basin B with the top closed by a cap of cement mortar. This stand requires that spouts be opened from the outside and unless they are properly made, the pressure will cause them to leak. With the other stands the spouts may open either from the outside or inside.

Overflow stands.

Overflow A is ordinarily made of a section of 16 inch pipe at the top of which is cut an overflow notch 5 or 6 inches deep and 7 inches wide and against this 16 inch pipe and cemented to it is a semi-circular or 2-3 circular section of an 8 inch pipe. The gate in the upstream compartment is a simple slide gate.

Overflow B consists of an overflow wall 2 inches thick built in a 14 or 16 inch pipe. Overflow C is made of two stand pipes connected with a short piece of 6 inch pipe.

Draining the pipes.

In order to empty the pipe to prevent bursting by freezing and also to flush out any silt, it is necessary that at all the lowest points openings controlled by valves or gates be provided.

Accessories.

The accessories needed for a pipe system are: (1) the galvanized iron spouts, (2) regulating gates, which are either the simple cast iron or steel slide gates or the pressure gates, (3) the valves. These devices are made by several manufacturers in southern California and vary in detail. Prob-

ably the largest factories are those of Kellar and Thomason Manufacturing Company at Los Angeles, and the Pomona Manufacturing Company at Pomona. The prices given below are for California. The first firm will deliver their appliances at Vancouver for the same prices as quoted for California points and for orders amounting to \$1,000, a discount of 10 per cent. is given, but to this the duty of 33 per cent. must be added. No doubt the second firm would give about the same prices.

Cost of Galvanized Iron Distributing Gates.

Diameter.	Price for light weight.	Price for heavy weight.
1 inch	4¾ cents	7 cents
1¼ "	5 "	
1½ "	5¼ "	10 "

Cost of Valves.

No. of valve.	Size of opening.	Price.
5	2½ inches	\$.70
6	2½ "	.75
8	5 "	.85
10	6 "	1.10
12	8 "	1.80
14	10 "	2.75

Cost of Gates.

Size of opening.	Cast iron slide gates.	Cast iron pressure gates.
6	\$1.60	\$ 3.40
8	1.75	3.85
10	2.50	4.60
12	3.60	5.90
14	4.60	7.85
16	5.70	10.25
18	8.20	12.50

Approximate Cost of Stands in Place.

Type of stand.	Price complete.
A	\$1.00 to \$1.50
B	.90 to 1.25
C	1.75 to 2.00
D	1.65
Overflow	2.75 slide gate.

5.—Pressure Pipe Lines and Valves.

On some of the orchards in the Okanagan and Grand Forks districts and also on orchards in Idaho and southern California, the water is distributed over the orchards in high pressure, wood-banded pipe lines. The pipe lines take the place of the head ditches; they are tapped at each row or wherever desired by a standpipe formed by screwing in the wood short sections of galvanized iron pipe capped by an ordinary garden valve to regulate the flow. Where the land is very irregular and it is desired to keep the water under pressure, this form of construction is the most desirable and in fact the only feasible one, but if it is possible to break the pressure and maintain it within the safe pressures for cement pipes by proper regulation, the cement pipe distributing system has the advantages of lowest cost, greater durability and better division of the water between furrows.

6.—Laying Out Furrows: Number, Length, Depth and Slope.

The number of furrows varies greatly with the opinion and judgment of the irrigator. For young orchards frequently only two furrows are used for each row of trees, one on each side of the trees. For older orchards usually at least three furrows are used, one on each side of the tree rows and one in the center between tree rows. To obtain a more uniform distribution of moisture, as many as six or eight furrows to each row of trees are used. The present tendency is to use deeper furrows and space them farther apart (Fig. 71). A depth of 8 inches is frequently used. In southern California orchards are usually furrowed with plows attached to the frames of wheeled cultivators in the place of the cultivator teeth (Fig. 72). Furrows 9 inches deep have a bottom width of 10 inches and a top width of 15 inches.

The experiments described under the distribution of water in furrow irrigation gave some interesting results which should guide the orchardist in adopting the best arrangement of furrows. These experiments showed that for a sandy soil with furrows 4 feet apart it took about 24 hours for the water to spread sideways and meet between the furrows; for a clay loam about 12 hours was sufficient. These experiments also showed that for a deep furrow the sideways spread was greater than for a shallow furrow. The sideways spread for sandy loam was limited to about 2 feet on each side of the furrow and for clay loam about 3 feet; this would indicate that the distance apart of furrows should be not over four feet for sandy loam and six feet for clay loam. The furrows on either side of the row of trees should be placed as near as possible to the tree to moisten the soil directly under the tree.

Fig. 73.—Method of laying out zigzag furrows.

(O. E. S. Bulletin 236, U. S. Dept. Agr.)

Usually the furrows are made parallel to the rows of trees. As the trees grow older it is not possible to get the furrows near the trunk which leaves a space between the trees in a row which is comparatively dry. To wet the soil more uniformly the land is cross furrowed so as to form zigzag furrows around the trees (Figs. 73, 74). The furrows indicated by the dotted lines are first made, then crossed at right angles and the necessary cuts and fills made with a shovel. Because of the greater length, slower velocity and the larger area wetted, the zigzag furrows receive a larger stream. Frequently only the lower half, third, or fourth of the furrows is zigzagged. This will tend to give the lower part of the orchard as much water as the upper part which otherwise receives a greater quantity.

The length of the furrows ranges usually from 330 to 1320 feet, which is the length of a 40 acre tract. As a rule the furrows should not exceed 660 feet and preferably 330 feet. On sandy soil, especially, short furrows not over 330 feet long are desirable; otherwise the upper side of the orchard receives a large excess of water before the lower part has received sufficient.

The grade of the furrows varies widely with the topography or lay of the land. Some orchards on flat valley soils do not permit of a steeper grade than 1 inch to 100 feet while orchards on steep side hills may require placing the furrows on much steeper grades. The proper grade depends much on the character of the soil. On ordinary soil a flat grade of 3 to 6 inches in 100 feet is preferable. On steep hillsides flat grades for the furrows can often be obtained by setting out the trees so that the furrows will run across the slope. Some soils that do not wash badly are irrigated successfully with furrows as steep as ten or twelve feet to the hundred, but usually such grades are excessive and require that very small streams be turned into the furrows and great care taken to prevent washing of the soil. Where steep grades are not avoidable short furrows should be used.

APPLICATION OF WATER.

1.—When to Irrigate Orchards and Quantity of Water to Use.

Most orchardists have their opinion as to when irrigation is necessary. They may be guided by the appearance of the fruits and the leaves, but the best way to determine the necessity for irrigation is by a study of the soil. This is best done by borings or excavating trenches to determine where the roots are and how much free moisture there is in the soil. The method of taking soil samples and the determination of percentage of free moisture in the soil have been explained (page 65). After the orchardist has become familiar with his soil and knows the best percentage of moisture for his trees, he may be able to tell readily by taking a sample of the soil in his hand whether there is sufficient moisture or not.

It has been stated above (page 65) that the minimum amount of free soil moisture in four feet of soil to keep apple trees in good growing condition has been found to be from 2.5 to 3 per cent. by weight. Dr. Loughridge found in his experiments on citrus orchards in southern California that the moisture content in the upper four feet varied from about 4.7 per cent. by weight before irrigation, to 9.64 per cent. immediately after irrigation for a sandy soil, from about 6.81 per cent. before irrigation to 11.27 per cent. immediately after irrigation for a sandy loam, and from about 5.47 to 10.86 per cent. for a heavy loam. The percentage of free moisture

6 weeks after irrigation was reduced by soil evaporation and plant transpiration to about the same or slightly higher than just before irrigation. Based on these figures with irrigation at six week intervals, the percentage of free moisture to add at each irrigation would be about 5 per cent. for sandy loam and 4.5 for clay loam or heavy loam, or about 5 pounds of water to 100 pounds of soil. For a soil air dried weighing from about 100 to 110 pounds, this is equivalent to about 1 inch of water to 12 inches depth of soil. This gives for the correct quantity of water to put in the upper six feet of soil in order to maintain the proper quantity of soil moisture, a depth of about 6 inches of irrigation, applied at six week intervals during the growing season.

These figures are based on results obtained for full grown citrus orchards which in California usually require about twice as much as apple trees or other deciduous trees. Therefore about 3 inches of irrigation water at each irrigation separated by intervals of 45 days should be ample. That this amount may be sufficient for a young orchard at least is shown by the following case in Idaho described by Don H. Bark, in charge of Irrigation Investigations for the U. S. Department of Agriculture. The orchard is a thrifty 5 year old orchard located at Twin Falls where the annual precipitation varies from about 8 to 18 inches. During the growing season of 1910 the rainfall was $1\frac{1}{2}$ inches and the depth of irrigation water applied was about $7\frac{1}{4}$ inches. The soil was kept well mulched by frequent cultivations and the moisture at the end of the season in the fall was fully as high as at the beginning of the season. This one case is not conclusive but it shows the possibilities of small quantities of water carefully used. The examples of net duty of water on orchards in eastern Washington and Montana given on page 61 indicate the quantities used with ordinary care in irrigation and cultivation. It is interesting to notice that the measurements made on citrus orchards showed that the amount of soil moisture supplied to sandy loam soil was practically the same as for heavy loam soil and clay loam. This is probably true of any soil which is sufficiently deep and not underlaid with a very open sandy or gravelly soil, in which case the soil should be irrigated more frequently and less depth of water applied at each irrigation.

2.—Number of Irrigations Per Season.

The number of irrigations will depend on the capacity of soil to retain water. The orchardist should be guided mainly by the examination of his soil and should try to keep the moisture content within the limits stated above; that is, the free moisture should be between 5 and 10 per cent. of the weight of the soil. For an open soil, well drained, or for a shallow soil, light irrigations applied frequently are best; for a deep retentive soil three to four irrigations 4 or 6 inches deep are ample. The practice in some of the fruit growing districts of Washington, Idaho, Montana and Colorado is described by Professor Fortier in U. S. Department of Agriculture, Farmers' Bulletin 404, on Irrigation of Orchards, as follows:

"In the Yakima and Wenatchee fruit-growing districts of Washington, the first irrigation is usually given in April or early in May. Then follow three to four waterings at intervals of 20 to 30 days. At Montrose, Colo., water is used three to five times in a season. At Payette, Idaho, the same number of irrigations is applied, beginning about June 1 in ordinary seasons and repeating the operation at the end of 30 day intervals. As a rule, the orchards at Lewiston, Idaho, are watered three times, beginning about

June 15. From two to four waterings suffice for fruit trees in the vicinity of Boulder, Colo. The last irrigation is given on or before September 5, so that the new wood may have a chance to mature before heavy freezes occur. In the Bitter Root Valley, Montana, young trees are irrigated earlier and oftener than mature trees. Trees in bearing are, as a rule, irrigated about July 15, August 10, and August 20, of each year."

R. W. Fischer, Horticulturist for the Montana Agricultural College, states the following:

"As a general rule, young trees need not be irrigated more than once or twice during a season. Old bearing trees will require from two to four irrigations. Young trees are irrigated about June 15th and possibly July 15th. Old trees are irrigated about June 15, July 1, July 20, and August 15th. In connection it may be added that the mean annual rainfall is about 12 to 15 inches, about half of which comes in the months of May, June, July and August."

3.—Fall and Winter Irrigation.

Experience shows that irrigation too late in the summer keeps the tree in growing condition and the immature growth is easily damaged by the early frost in the fall. This is one of the causes of winter killing of trees. On the other hand when irrigation is stopped too early in the summer and the soil is not retentive, there is insufficient water to meet the demands of soil evaporation and of tree transpiration during the fall and winter, and the soil becomes too dry for the trees, which are consequently damaged or killed. In many orchards the practice is not to irrigate after the beginning of August. In some cases, especially on porous non-retentive soils, it would be well to irrigate in the fall or mid-winter after the leaves have fallen and when there is no danger of starting a second growth. The proper time for this last irrigation would be in late October or in November and only sufficient water should be added to moisten the soil.

4.—Running Water in the Furrows.

The stream of water or heads used in orchard irrigation depend on the manner of delivering and the depth applied on the land. Some canal companies deliver a continuous flow in proportion to the area irrigated, others deliver the water in turns or rotation and each irrigator receives a larger head than by continuous flow for a portion of the time. The second method is preferable. It lessens the losses of evaporation and seepage, eliminates the waste of a continuous flow when not in use, enables the irrigator to apply the water in a short length of time, and encourages proper application of water.

The heads delivered to the irrigator for orchard irrigation by furrows may range from a few miners' inches to 100 or more miners' inches. For small orchards heads of from $\frac{1}{2}$ a cubic foot per second to 1 cubic foot per second or 20 to 40 miners' inches are desirable. The table below gives the time necessary to irrigate 4 inches deep, different size orchards with different sizes of streams:

Size of stream, miners' inches.	Number of days required to irrigate, 4 inches deep, orchards of					
	5 acres.	10 acres.	15 acres.	20 acres.	30 acres.	40 acres.
5.....	6 days	12 days	18 days	24 days	36 days	48 days
10.....	3	6	9	12	18	24
20.....	1½	3	4½	6	9	12
30.....	1	2	3	4	6	8
40.....	¾	1½	2¼	3	4½	6

The number of furrows into which the irrigating head may be divided will depend much on the character of the soil and-grade of furrows. In some cases one half a miners' inch or even less may be run into each furrow while for some sandy soils it is necessary to use 3 or 4 miners' inches in order that the water will reach the lower end of the furrow and not be all absorbed at the upper end. On tight soil a small stream must be used in order that it will run slowly in the furrows and give time for the water to percolate into the ground without a waste at the lower end. To prevent the upper end of the furrows from receiving too much water it is always desirable to begin with a large stream into each furrow and rush the water to the lower end, then reduce the size of stream to obtain an even distribution.

With furrows 330 feet long, 6 feet apart, and a British Columbia miners' inch to each furrow, the time which the water must run to give an average depth of water on the soil of 6 inches is about 10 hours. Depending on the nature of the soil and length of the furrow, the time the water is run into the furrows varies from 4 to 48 hours. Prof. R. W. Fischer, of Montana, found that on the clayey loams of the apple orchards on the east bench of the Bitter Root River, it requires from 12 to 18 hours to moisten the soil in furrow irrigation, 4 feet deep and 3 feet sideways.

5.—Prevention of Losses of Water Applied; and Cultivation.

The losses which occur in the application of water to the soil are:

1st. The losses due to unequal distribution of water in the soil caused by deep percolation and waste at the upper end of the fields, unequal division of water between furrows, and excessive use of water which is not retained by the soil.

2nd. Loss from neglect, because of careless irrigation which allows waste in the low places and at the ends of the furrows, causing injury to roads and adjoining orchards or farms.

3rd. Loss by evaporation of the water in the furrow itself and especially of the soil moisture from the wet soil.

The remedies to minimize the losses due to unequal distribution of water in the soil and the waste due to deep percolation have been fully discussed in the preceding pages. The loss from neglect can be largely prevented by care. The losses due to evaporation can be lessened by applying the water in deep furrows and by thorough cultivation.

Irrigation with deep furrows places the water well below the surface and does not wet the surface soil to the same extent as with shallow furrows; this decreases the evaporation loss and permits cultivation of the orchard soon after irrigation. It also encourages deep rooting which is always desirable except where the soil is very shallow.

Cultivation is one of the most important factors not only to prevent evaporation, but to improve the condition of the soil. To prevent evaporation the soil should be cultivated immediately after each irrigation. Professor Fischer, Horticulturist for the Montana Agricultural College, states that as a general rule orchards should be cultivated every ten days during the growing season until about August 1st. Cultivation should stop at that time, especially in young orchards in order to induce the trees to mature, thus putting them in better condition to endure freezing temperatures in the early fall and winter. He describes the process of cultivation in Montana as follows:

"Orchard soils are usually plowed in the spring during April or early May. This plowing may be done with a two horse team using a fourteen inch plow. The plowing should be from six to eight inches deep. The soil is turned towards the trees one year and away from them the following year. The last one or two furrows near the trees can be plowed with a one horse eight inch plow plowing only from four to six inches deep so as not to interfere with the roots near the trunk. On soils that work easily it is sometimes possible to cultivate the soil deep enough with the disc harrow, thus doing away with the spring plowing. After plowing the land should be smoothed using a smoother or leveler. After smoothing the soil is cultivated with a spring tooth harrow going at least two ways in the orchard. This is followed with a spike tooth or smoothing harrow."

A deep granular mulch 6 to 8 inches thick is much more effective for deep soils than one only 3 or 4 inches thick. If thorough cultivation is practiced, frequent irrigation is not necessary. Irrigation water can not take the place of frequent and thorough cultivation. The effects of irrigation in furrows of different depths and of mulches of different thickness have been determined quantitatively by the experiments previously described (pages 68 to 72).

VI.—IRRIGATION OF POTATOES.

1.—Selection of Soil.

Potatoes are grown very profitably in many of the irrigated districts. They may be grown separately as a commercial crop on land devoted to this purpose, or they may be planted between tree rows in order to obtain some income from the land while the trees are young and for this purpose they are preferable to deep rooted plants which are always more or less detrimental to the proper growth of an orchard. They can also be grown on land which is to be planted in fruit trees, for the purpose of improving the texture of the soil.

Potatoes which are grown on orchard soils either prior to planting the orchard or while the trees are young, can not be expected to give as large yields as obtained on soils which are selected for the purpose of growing potatoes. Orchard soils are not always well suited for large yields of potatoes. This is especially true of a soil which is deficient in organic matter, but the continuous cultivation, the irrigation and the digging up of the soil when harvesting the crop in the fall will very much improve the condition of the soil.

When potatoes are to be grown separately and for the chief purpose of obtaining maximum production, the soil should be carefully selected and given proper treatment. The best soil is a sandy loam of fairly porous soil, well drained, with sufficient humus or decayed organic matter to put it in good condition and increase its power to retain moisture.

2.—Treatment of Soil.

To obtain heavy yields sandy soils must usually be prepared by growing a foundation crop which will add humus to the soil. The best crops for this purpose are alfalfa, clover, and peas. To keep the land in good productive condition the rotation of crops is usually advocated. A common practice in Colorado is to grow either clover or alfalfa for two years, potatoes for two years, and grain or peas for one year; this last crop is sometimes omitted.

Where alfalfa is the foundation crop it is rather difficult to plow it up. This is usually done by plowing the alfalfa when it is blooming, first shallow to a depth of 3 or 4 inches, in order to turn over the plant and cut off the crown at that depth to expose the roots to the sun. This is followed by a deep plowing in the fall which leaves the land in good condition for the potato crop.

New land is broken up in the fall previous to growing crops by plowing deeply and allowing it to stand in that condition until spring when it is either worked up by a shallow plowing 4 to 6 inches deep and then harrowed, or simply pulverized and worked up with a disk or spring tooth harrow.

3.—Planting Potatoes.

The time of planting varies with climatic conditions and the kind of potatoes. Early potatoes are planted in the spring as soon as the frost is out of the ground and when there is no danger of late hard frosts. Late potatoes may be planted as late as the middle of June, but usually earlier is more desirable, especially where there is a deficient water supply in the late summer.

The depth of planting depends on the condition of the soil and the kind of potatoes. Early potatoes planted in moist retentive soil are placed 2 to 2½ inches deep; where the soil is not retentive and is dry, or where there is danger of heavy frost, 4 inches is better. The rows are spaced 36 to 42 inches apart and the hills in the rows 12 to 15 inches apart; on rich land they may be placed as close as 8 inches apart.

The seed may be either whole or cut. Good size seed must be used. In Colorado medium size whole seed as large as two ounces is preferred. Four ounce potatoes are cut in two and six ounce potatoes in three. Potatoes raised on irrigated land are not considered the best for seed, and dry land seed from Wisconsin, Minnesota or from non-irrigated land of Colorado, are generally used in that State. It is important that the seed be properly selected. A uniform size is desirable. Seed averaging 1½ ounces in weight and spaced 12 inches apart in rows spaced 40 inches apart will require about 1200 pounds of seed to the acre.

For small areas the seed is placed in the furrow and pressed by hand, then covered with plow or harrow. For large areas mechanical planters drawn by a horse are used. They will open the furrow, place the seed, cover it, and pack the soil.

4.—Cultivation.

The cultivation should begin soon after planting. The first cultivation between the rows which are indicated by the tracks of the planter, begins a week after planting. This cultivation should be 8 or 10 inches deep in order to well aerate the soil and kill the alfalfa which may have a tendency to sprout again. The cultivator drawn by two horses, has four shovels, two for each side of the row; they are 4 to 5 inches wide and 14 to 15 inches long. The cultivator is followed by a harrow. Cultivation is continued with the harrow passed over the land in both directions once a week, if possible, until the plants are 5 or 6 inches high. Shallow cultivations after each irrigation until the plants cover the ground is desirable.

5.—Quantity of Water Required for Potatoes.

Experiments made by the Agricultural College of Utah on the relation of yield to quantity of water used, gave the following results:

Locality.	Depth of water applied in inches.	Yield in bushels per acre.
Salt Lake County.....	7½	210
	10	217
	11¾	258
	16¼	270
	20½	265
Morgan County.....	17¾	257
	19¼	325
	19¾	227
	21½	250
	25½	282
	26	205
Experiment Station Plat	9	124
	15	217
	20	446
	27	362
	40	523

The above results show that 16 to 20 inches of water will give a yield nearly as great and in some cases greater than a larger quantity. This is also corroborated by measurements made by D. H. Bark in Idaho in 1910. The results obtained are given below.

Number of irrigations.	Date of first and last irrigation.	Total depth applied in inches.	Yield, tons per acre.			Percentage marketable.
			Marketable.	Culls.	Total.	
3.....	May 13-July 15	10½	2.16	.99	3.15	68½
5.....	May 13-Aug. 9	18	4.40	1.56	5.96	75
6.....	May 13-Aug. 18	24½	3.93	2.54	6.47	61

These potatoes were planted June 1st and 2nd at the rate of 1,000 lbs. to the acre on fall plowed land which had been in grain during the season of 1909. The land received one irrigation before planting. The water was applied in deep furrows 220 feet long and the land was cultivated six times. Mr. Bark states that the yields were very unsatisfactory owing to the poor stand secured, but it is thought that the amounts applied would have been sufficient for maximum crops had the stand been good.

While these experiments are not conclusive, they are of value in showing that the bigger yields are not always obtained with the largest quantity of water and that above a certain depth of water the increase in yield, if any, is small as compared to the increase in quantity of water applied. The yield does not depend entirely on the quantity of water applied but on the time of application and the care in planting and cultivation.

6.—Time to Irrigate.

Soil which is moist and retentive does not need any irrigation before planting, but for dry soil or for late planting one irrigation before planting followed by cultivation, is necessary. During the first stages of growth thorough cultivation is more important than irrigation and no irrigation may be necessary until July. The number of irrigations will vary from two to four for ordinary sandy loam, but on porous, sandy soil or on shallow soil which does not retain moisture, five or even six shallow irrigations may be preferable. Frequent irrigation, especially early in the season when the water is cold, will retard the growth. The moisture in the soil should be kept fairly uniform until the tubers begin to form, when a large quantity of water is required. The need of irrigation may be indicated by

the appearance of the plants such as the darkening of the leaves, or preferably by an examination of the soil under the surface where the tubers form. The soil is in good condition when a ball of earth squeezed in the hand will retain its shape.

The last irrigation should be applied before the growth of tuber ceases in order to give about one month and a half to two months for ripening in dry earth. Where potatoes are grown between tree rows, late irrigation and cultivation after the first of August will keep the orchard in growing condition too late in the fall and will not give the wood sufficient time to mature before the first hard frosts.

7.—Method of Irrigation.

Potatoes are irrigated by furrows made midway between the rows. The furrows are made by a double mouldboard plow which forms a V trench, the bottom of which should be about 6 to 12 inches below the crown of the plant. The length of the furrows should not be over 200 or 300 feet for porous sandy soil and not over 500 to 600 feet for more retentive loam. Greater lengths give unequal distribution of soil moisture with an excess or waste at the upper end due to deep percolation.

A common practice in Colorado is to open alternate furrows for the first irrigation, and for the next irrigation open the furrows in the intervals between rows which were left unopened in the first irrigation. For more than two irrigation the alternation is repeated.

The division of water between furrows, the size of the stream delivered to each furrow, the length of time the stream is run into the furrows, are the same and controlled by the same factors as the irrigation of orchard and alfalfa by furrows previously described.

Potato vines are shallow rooted and the frequent application of cold water no doubt retards their growth; for this reason some irrigators prefer to apply the water at night when the soil and water have had all day to warm up in the sun. This practice also has the advantage that the loss of moisture by evaporation is decreased. Many growers object to night irrigation because of the night work necessary to distribute the water. However, this may be cut down to a minimum by a proper preparation of the ground and the regulation of the water delivered to the furrows by placing spouts in the banks of the head ditch at the head of each furrow or by using for the head ditch a flume with auger holes as described for orchard irrigation.

Additional information on the agricultural phase of potato growing may be obtained by consulting the following bulletins:

Potato Investigations, Bulletin No. 94, Agricultural Experiment Station, Pullman, Washington.

Potato Culture on Irrigated Farms of the West, Farmers' Bulletin 386, U. S. Department of Agriculture, Washington, D. C.

VII.—IRRIGATION OF ALFALFA.

The value of alfalfa as a forage crop and as a foundation crop for orchards or potatoes to be grown on soils lacking fertility, make it desirable that information on the proper methods of irrigation of this crop be included in this bulletin. The growing of alfalfa is not widespread in British Columbia, but its rapid spread in almost every state of the United States makes it reasonable to expect that it will become a more important crop.

1.—Methods of Irrigation.

The methods of irrigation given for alfalfa will apply to practically all forage crops as clover, peas, etc. Because of the rolling character of most of the irrigable land of British Columbia, the method best adapted to the irrigation of alfalfa is the furrow method, almost universally used in the Yakima Valley of eastern Washington, and often spoken of as the Yakima or corrugation system. Another system adapted to rolling land and used extensively in the Rocky Mountain states—Colorado, Montana, Wyoming and Utah—is known as the flooding method. It consists in running small parallel ditches through the fields, 50 feet to as much as 200 feet or more apart, and running the water over the bank of the ditches down the slope of the fields. This method requires an irrigating head of from 40 to 100 miners' inches or 1 to 2½ cubic feet per second and is more wasteful than the corrugation method. The other methods of irrigation commonly used are known as the border method and the check method. These are adapted only to comparatively level land and require large heads of water. Only the first method will be described as it is the one best adapted to most of the irrigable land of British Columbia. The other methods are fully described in Farmers' Bulletin 373 on Irrigation of Alfalfa, which can be obtained from the U. S. Department of Agriculture, at Washington, D. C.

Furrow method of alfalfa irrigation.

The water is run in shallow furrows from which it spreads laterally and moistens the soil on each side. The laying out of the head ditches or flumes, the length and slope of the furrows, and the application of the water is much the same as for orchards. The farmer often makes his furrows too long in order to avoid many head ditches. This is poor practice for it causes unequal distribution of water with a loss by percolation at the upper end of the furrows. It is best to plan the distribution system so

Fig. 75.—Distribution system for ten acre tract, Kenewick, Wash.

(O. E. S. Bulletin 188, U. S. Dept. Agr.)

that the furrows do not exceed 660 feet for ordinary loam soils and 330 or even 220 feet for porous sandy soils. This requires that the field be cut up by two or more head ditches or head flumes fed by the supply lateral. A typical wooden flume distribution system for an alfalfa field at Kennewick, Washington, is shown in the accompanying diagram (Fig. 75). The furrows are made 3 to 6 inches deep, about the same width, and spaced from 18 inches to 4 feet apart, depending on the character of the soil. The furrows are commonly made by the use of a marker or furrowing sled which may be a rough implement made of logs fastened together and spaced the right distance apart, but preferably made of timber as shown below (Fig. 76). This leaves a smooth furrow without clods to interfere with the flow.

Fig. 76.—Furrowing Sled.

(Farmers' Bulletin 392, U. S. Dept. Agr.)

The water is divided and distributed into the furrows from the head ditch or flume as for orchard irrigation, usually from spouts placed in the ditch bank or from holes bored in the side of the flume. At first a larger stream is turned into each furrow to rush it through to the lower end and then the opening is regulated to give a small stream which is allowed to run 12 to 24 hours for furrows 330 to 660 feet long and 24 to 48 hours for furrows 660 to 1320 feet long. For porous soil a larger stream for a shorter time should be used. With furrows 2 feet apart and 330 feet long it will require about 1-5 miners' inch to each furrow, running for 24 hours, to give a depth of 9 inches of water on the land. The practice in the Yakima Valley is to make the furrows 18 inches apart when the land is first seeded and to abandon every other one after the plants are well rooted.

2.—Amount of Water Required.

The duty of water measurements given for alfalfa (page 62) show the great variations in quantity of water applied by different irrigators in different localities. These quantities do not give any idea of the correct quantity of water to use. The maximum yield of alfalfa obtainable in any case will depend not only on the quantity of water used, but on the time when it is applied. When properly applied it has been found that different quantities of water will give different yields but that the increase in yield is not in direct proportion with the increase in quantity of water applied and there is no doubt for every particular case, a depth of water which will give a maximum yield and any quantity applied above that is not only wasted but decreases the yield because of the excess moisture in the soil. Professor Fortier in 1903, when director of the Montana Experiment Station, made experiments on seven plats of alfalfa to determine the relation between quantity of water applied and yield. The results obtained are given in the following table taken from U. S. Department of Agriculture, Farmers' Bulletin 373 on Irrigation of Alfalfa.

**Quantities of Water Applied to Alfalfa and Yields Secured, Montana
Experiment Station.**

Plat number.	Depth of irrigation.	Depth of rainfall.	Total depth.	Yield per acre of cured alfalfa.
1.....	.5 ft.	.70 ft.	1.20 ft.	4.61 tons
2.....	None	.70	.70	1.95
3.....	1.0	.70	1.70	4.42
4.....	1.5	.70	2.20	3.75
5.....	2.0	.70	2.70	6.35
6.....	2.5	.70	3.20	7.20
7.....	3.0	.70	3.70	7.68

Mr. Alex. McPherson, Secretary of the Idaho Board of Horticultural Inspection, states that in southern Idaho 24 inches of water applied produced the maximum crop of alfalfa amounting to seven tons of baled hay, while thirty-six inches produced six and one-third tons; besides the field was damaged to some extent by excessive use of water.

Mr. Don H. Bark, in charge of Irrigation Investigations in Idaho, has carried on during the past two seasons some very interesting experiments on the water requirements of plants and duty of water. The method used was to select fields averaging about 15 acres on typical farms of the state. These fields were divided into three equal parts. On one part the owner used the same manner of irrigation and same quantity of water as had been his usual custom. On the second part a greater amount was used and on the third part, a smaller amount. The water was carefully measured and the yields weighed to determine the amount giving the greatest yield. The results obtained for the different crops, grain, alfalfa, and clover, are given in the Eighth Biennial Report of the State Engineer of Idaho.

The only experiment for red clover was made on a two year old clover field with very sandy and gravelly soil. Below 2 feet from the surface and extending to a depth of at least 100 feet, the subsoil was of 35 to 40 per cent. sand and 60 to 65 per cent. coarse gravel. The water table was 55 feet from the surface. The field was irrigated by flooding, the water being run over the surface distances from 910 feet to as much as 2359 feet. The results obtained were as follows:

Number of irrigations.	Total depth of water applied.	Yield per acre.
7	6.92 feet	3.78
9	8.40	4.85
10	11.74	4.60

The greatest yield was obtained with the medium amount of water. But in all three cases the quantities used are very large and include a waste due to the very open character of the soil and to the long distance the water is run. A large proportion of the water is lost by deep percolation, especially at the upper end of the field. The waste could be lessened by running the water shorter distances, preferably less than 500 feet.

The experiments for alfalfa were made on a variety of soils. A very sandy and gravelly soil, very similar to the above, was irrigated in the same manner, the water being flooded distances from 1979 to 2550 feet.

Number of irrigations.	Total depth of water applied.	Yield per acre.
4	6.35 feet	3.78
6	6.92	3.65
7	9.40	5.2

The greatest yield was obtained from the greatest amount of water. In this case also water was flooded much too far and the loss by deep percolation is no doubt very great. The waste could be very much lessened by using frequent light irrigations and shortening the distance the water has to travel. Because of the waste in both of the above gravelly soils, these results do not represent the correct quantity of water to use.

On a very sandy loam of fine texture down to a depth of 6 feet or more, the yields obtained for four year old alfalfa were as follows:

Number of irrigations.	Total depth of water applied.	Yield per acre.
3	1.61 feet	4.44
5	2.65	4.28
7	4.82	4.57

The field was well prepared for irrigation. The yields were nearly the same for the different depths of water applied.

For a clay soil 6 feet or more deep with a thin layer of hardpan 2 or 3 feet below the surface, the yields of an alfalfa field 5 years old were:

Number of irrigations.	Total depth of water applied.	Yield per acre.
8	1.89 feet	4.00
8	2.85	3.66
9	3.45	4.37

While the yield was greatest for the largest quantity of water used, it was not much greater than that obtained where the smallest quantity of water was used.

On a clay loam of the same character as the above clay soil the yields from a one year old alfalfa field were:

Number of irrigations.	Total depth of water applied.	Yield per acre.
7	1.43 feet	2.85
7	2.11	4.93
7	2.25	4.35

The results obtained from these experiments show that on gravelly soil a much larger quantity of water may be used than on more retentive soil. But the quantities used do not represent the amount of water required for they include large losses due to deep percolation which can be very much reduced by running the water shorter distances and using light irrigation applied more frequently. As a rule the yield seems to increase with the quantity of water applied, but the increase in yield in most cases is slight for a considerable increase in quantity of water and in some cases a greater yield was obtained with the smaller quantity.

The U. S. Department of Agriculture has made experiments on thirty plats of alfalfa at the University Farm at Davis, California, to determine the best use of water on alfalfa. The yields obtained for varying amounts of water are as follows:

Depth of water applied.	Yield in tons per acre.	
	In 1910.	In 1911.
None.....	4.08	6.03
12.....	4.79	7.52
24.....	6.43	8.38
30.....	8.09	9.50
32.....	.....	9.20
36.....	7.60	9.33
48.....	8.45	9.65

The plants were two years old in 1910 and three years old in 1911. The rainfall during the fall, winter and spring preceding the summer of 1910 was about 12 inches, and preceding the summer of 1911 it was about 22 inches. The rainfall during the growing season from the beginning of April to the end of October in both years was less than 1 inch. The soil was a sandy loam of great depth and the substantial yields obtained without irrigation show the power of this soil to retain the moisture produced by the winter and spring rains. The results show that the yield increases materially with an increase in the amount of water applied up to 30 inches, which gave a greater yield than 32 or 36 inches and almost as great as 48 inches.

The experiments made in Montana, Idaho and California, described above seem to indicate that 30 inches of water carefully applied will give almost maximum yields. While greater yields may be obtained by adding greater quantities of water, the increase is only small and will in most cases not pay for the extra water. Where water is valuable it may be more economical to use even less than 30 inches. The best practice in southern California where water is valuable compares closely with the experiments mentioned. At Pomona, California, the rainfall for 1903-4 was about 9 inches; the quantity of water applied by pumping averaged 2.3 feet in depth and the yield of cured hay averaged 1 to 1.5 tons per acre per cutting, five or six cuttings being common.

3.—Number of Irrigations.

Where there is sufficient moisture in the soil due to rainfall no irrigation may be necessary for the first crop. For each succeeding crop it is common practice to apply one irrigation either before or after cutting. On gravelly porous soil and on shallow soils, two or even three irrigations for each crop may be preferable. Irrigation before cutting is the custom in the Yellowstone Valley of Montana. It has the advantage that the soil being shaded by the plant, the evaporation of soil water is decreased. It also tends to prevent baking of the soil and permits an earlier irrigation for the last crop, which is an advantage if the available water runs short before the end of the season. The disadvantages of irrigating before cutting are that the plants interfere more or less with the distribution of water and that the soil may take considerable time to dry out sufficiently to permit harvesting. For these reasons many irrigators prefer to irrigate after each cutting.

4.—The Proper Time to Irrigate Alfalfa.

Farmers' Bulletin No. 373 on Irrigation of Alfalfa, written by Samuel Fortier of the U. S. Department of Agriculture, gives the following information on the proper time to irrigate alfalfa, winter irrigation, winter killing and seeding of alfalfa:

"The general appearance, and more particularly the color of the plant, are the best guides, perhaps, as to when water is needed. When healthy and vigorous, alfalfa is of a light-green color; but when the supply of moisture is insufficient the leaves take on a darker and duller shade of green and begin to droop, and unless water is provided both stems and leaves wither and die. Another test is to remove a handful of soil 6 inches or so beneath the surface and compress it in the hand. If it retains its ball-like shape after the pressure has been removed, and shows the imprints of the fingers, the soil is sufficiently moist, but if it falls apart readily it is too dry. In connection with such tests it is well to bear in mind that they are more or less influenced by both soil and climate. It is therefore necessary to observe the growth of the plant closely on all new alfalfa fields to determine if possible how far such tests may be relied upon, the chief object being to maintain at all times as nearly as practicable the proper amount of moisture in the soil surrounding the roots of the plants to prevent a checking of their growth.

"Alfalfa commonly receives careless treatment at the hands of western irrigators. When water is available and is not needed for other crops it is usually turned on the alfalfa fields or meadows whether these need it or not. There is no question that yields of alfalfa might be considerably increased if more care was used in finding out when to apply water. In each kind of soil and under any given set of climatic conditions there is a certain percentage of soil moisture which will give best results. Under the present unskillful practice it is impossible to maintain uniform soil-moisture conditions for any length of time. The soil is apt to receive too much or too little water, or else it is deluged with cold water at a time when it needs only heat and air. The number of irrigations required depends upon the depth and nature of the soil, the depth to ground water, the number of cuttings, and the rainfall, temperature, and wind movement. Other things being equal, more frequent waterings are required in the warm sections of the South than in the cooler portions of the North. The number of irrigations per year for alfalfa ranges from 4 in Montana and Wyoming to as many as 12 in parts of California and Arizona. In localities where water is scarce during part of the season the number of waterings as well as the amount used each time depends on the available supply. It is a common practice to apply frequent and heavy irrigations in spring when water is abundant and to water less often and more sparingly when the supply is low."

5.—Winter Irrigation of Alfalfa.

"When water is applied either to bare soil or to crops outside of the regular irrigation season it is termed winter irrigation. The practice thus far has been confined largely to the warmer parts of the arid region. It has become well established in Arizona and California and is being quite rapidly extended to parts of Oregon, Kansas, and the Rocky Mountain States.

"Experience has shown that a deep retentive soil is capable of storing a large quantity of water. On account of the fluctuation of western streams of all kinds, from the small creek to the large river, the greatest flow of water often comes at a season when there is least demand for it. In a few localities adequate storage facilities have been provided to retain the surplus, but as a rule it is allowed to go to waste. The passage of so much waste water led to the introduction of winter irrigation and in nearly every case the results have been satisfactory. The chief differences between winter and ordinary irrigations are the larger volumes used, the crude manner of conveying and applying the water, and the dormant or partially dormant condition of the plants at the time of irrigation.

"Besides furnishing a supply of much-needed moisture, winter irrigation when conditions are favorable, prevents winter killing and improves the mechanical condition of the soil."

6.—Winterkilling of Alfalfa.

"In the colder portions of Montana, Wyoming, Colorado, Utah, and the Dakotas alfalfa is apparently winterkilled from a variety of causes and sometimes from a combination of causes. The percentage of loss around Greeley, Colo., has been placed at 2 per cent. per annum. In this locality and throughout the Cache la Poudre Valley in northern Colorado most of

the winterkilling is done in open dry winters and is quite generally attributed to a scarcity of moisture in the soil. In the winter of 1907 considerable damage was done to the alfalfa fields around Loveland, Colo., on account of the long dry spell in midwinter. The old alfalfa fields suffered most. It was the opinion of the farmers that a late fall irrigation would have prevented the loss.

"Near Wheatland, Wyo., the higher portions of the fields suffer most damage in winter, and here also the cause is said to be lack of moisture in the soil, combined with the effects produced by cold and wind.

"At Choteau, in northern Montana, a farmer watered, late in the fall, part of an alfalfa field which was 2 years old, and it winterkilled, while the unwatered portion escaped injury. This and other evidence along the same line which might be given go far to demonstrate that under some conditions too much moisture is as detrimental as too little.

"Probably the chief cause of the winterkilling of alfalfa is alternate freezing and thawing. The damage from this cause is greatly increased when any water is left standing on the surface. A blanket of snow is a protection, but when a thin sheet of ice forms over portions of a field the result is usually fatal to plants. The bad effects of alternate freezing and thawing on alfalfa may be observed at the edge of a snow bank. This crop is likewise injured by the rupture of the tap roots caused by the heaving of the soil.

"From present knowledge of the subject, the means which may be used to protect alfalfa fields from winterkilling may be summed up as follows: Where both the soil and the air are dry the plant should be supplied with sufficient water for evaporation, but the land should be drained so thoroughly that none of the top soil is saturated; a late growth should not be forced by heavy irrigations late in the growing season; if the soil is dry, irrigate after the plants have stopped growing; and the latest growth should be permitted to remain on the ground, unpastured, as a protection.

"It may be stated in conclusion that the loss to the farmer from the winterkilling of alfalfa is not as great as might appear at first. The damage is done in winter, and there is ample time to plow the plants under and secure another crop, which is usually heavy, owing to the amount of fertilizers added by the roots of alfalfa. The Montana farmer who increased his average yield of oats from 50 to 103 bushels per acre by ploughing under winterkilled alfalfa illustrated this point."

7.—Seeding Alfalfa on Land to Be Irrigated.

"In the upper Snake River Valley, in Idaho, alfalfa is usually preceded by a grain crop. The stubble is plowed 6 to 9 inches deep in the fall, and early in the spring it is double-disked, harrowed, and smoothed. From 8 to 20 pounds of seed is then drilled in 0.75 inch to 1.5 inches deep in rows 6 inches apart. When oats is used as a nurse crop it is seeded first, 80 to 100 pounds per acre being used. From 8 to 12 pounds of alfalfa seed are then drilled in, in the opposite direction. Some farmers use a combination drill which seeds both at the same time. When no nurse crop is used the alfalfa plants are clipped when they reach a height of 8 to 12 inches. This is necessary to hold the weeds in check and to cause the plants to stool.

"In the Yakima Valley, March and April are preferred for seeding alfalfa, both on account of the climate and the abundant water supply of that period. The ground is plowed deep, graded, smoothed, and harrowed. From 10 to 20 pounds of seed are then put in with a broadcast seeder and harrowed lightly. The furrows are then marked off and irrigation begins. The ground is kept moist constantly until the young plants are fairly well established. The use of so much water at the start is due largely to the tendency of the soil to bake if allowed to become dry.

"The alfalfa growers of Montana are about equally divided in opinion as to the advantages of using a nurse crop. Those who seed grain with alfalfa claim that they get more out of the land the first season, while those who are opposed to this practice believe that the injury done to the alfalfa plants by the grain crop extends through several years and that the small gain of the first year is more than offset by the lessened yields of alfalfa in subsequent years.

"In northern Colorado, rotation of crops is practiced and alfalfa seed is sown with a nurse crop, usually wheat or barley. The seed is drilled early in the spring with a common force-feed press drill equipped with an auxiliary seed box for alfalfa seed, which is scattered broadcast between the grain rows and covered by the disk wheels of the press drill. From 12 to 20 pounds of alfalfa seed are sown. Irrigation before seeding is not practiced. There is, as a rule, sufficient rainfall to furnish both crops with moisture until the grain is ready to head out and the alfalfa is 4 to 6 inches high, when the field is irrigated.

"At Wheatland, Wyoming, various methods of seeding alfalfa are in use, but the one which gives the best results may be described as follows: Drill in 1 bushel of barley to the acre; then in a week or ten days cross drill the field, sowing 12 to 15 pounds of alfalfa, setting the press drill so that the seed will be covered 0.75 inch to 1.5 inches deep."

Information on the various agricultural questions involved in alfalfa growing and its use can be obtained in the following bulletins:

Alfalfa Growing, Farmers' Bulletin No. 215, U. S. Department of Agriculture, Washington, D. C.

Alfalfa Bulletin No. 66, Agricultural Experiment Station, Moscow, Idaho.

VIII.—THE USE OF SMALL PUMPING PLANTS FOR IRRIGATION IN BRITISH COLUMBIA.

While British Columbia is favored with a system of large rivers such as the Thompson, the Fraser, the Kettle Valley and lakes such as the Okanagan, these splendid large bodies of water are practically not available for gravity irrigation because of the topography of the irrigable land. The irrigable land exists usually in separate small valleys formed on both sides of smaller streams, or in small benches high above the rivers or lakes, generally with considerable slope towards these bodies of water. This position of the irrigable land combined with the flat grade of the rivers makes diversion by gravity flow directly from these sources an economical impossibility. These conditions have made it necessary to utilize the smaller streams or creeks, the flow of which is irregular, being abundant at the beginning of the irrigation season but in many cases decreasing to an insufficient volume before the close of the season. Most of the watersheds of these streams are favored with reservoir sites which can be utilized at a moderate cost to regulate the flow. Up to the present the natural stream flow, supplemented in some cases with storage water, has been the usual source of supply. Naturally the systems most easily constructed were installed first and the best available sources have been taken up. With the increasing demand for water to put new land under irrigation, less favorable sources of water supply must be utilized and the cost of development will become greater. There will still remain bodies of land for which no gravity water is available or only available at a very high cost, and which may be situated at a moderate elevation above the large rivers or lakes. For these conditions the development of a water supply by pumping may be the best solution. The information given below applies to small pumping plants, irrigating from about 10 to 100 acres.

CONSIDERATIONS CONTROLLING THE SELECTION OF A PUMPING PLANT.

The proper selection of a pumping plant depends upon many factors which should be carefully considered by the intending purchasers. These factors are: (1) capacity of plant and period of operation, (2) the kind

of pump, (3) the class of engine or driving power, (4) the first cost, (5) fuel cost, (6) cost of fixed charges and attendance. These factors are interdependent and should be considered together. Their relative importance will vary with local conditions and for that reason it is not possible to state definite rules which will apply in all cases. A study of the conditions affecting each factor is therefore necessary in each case.

1.—Capacity of Plant and Period of Operation.

The required capacity of the plant will depend on the area irrigated, the duty of water or depth of water required on the land and the period of operation. For ordinary orchard soil in the arid part of British Columbia a total depth of 12 inches of water during the irrigation season will be sufficient for young orchards. For a full bearing orchard 18 inches should be ample, while for alfalfa and other forage crops 24 to 36 inches is plenty. Where the cost of pumping is high, such as for small plants and high lifts, it will usually not be feasible to grow at a profit anything but orchards. To reduce the cost of pumping, no excess water should be used, all losses should be prevented by careful irrigation and thorough cultivation, in which case a young orchard on fairly deep retentive soil may not require more than 6 to 9 inches of irrigation water and a full bearing orchard not more than 12 or 15 inches during the irrigation season. To put a depth of 2 feet of water on one acre, it takes a flow of very nearly 1 cubic foot per second for 24 hours; this is equivalent to 450 U. S. gallons per minute for 24 hours. This relation can be applied to any case to obtain the size of the pump. For example, if it is desired to irrigate a 40 acre orchard $1\frac{1}{2}$ feet deep, in an irrigation season of 120 days, this requires 60 acre feet in 120 days, or $\frac{1}{2}$ of an acre foot per day. This will be obtained by a pump giving $\frac{1}{4}$ of a cubic foot per second, or 110 U. S. gallons per minute, when the pump is operated continuously 24 hours a day every day during the irrigation season of four months. For a 10 acre orchard the required capacity based on the same conditions would be $\frac{1}{4}$ the above or 28 gallons per minute or 1-16 of a cubic foot per second, or about $2\frac{1}{4}$ British Columbia miners' inches.

The above two examples are based on a pump operating continuously at the rates given above. While continuous operation decreases the required size of plant, it is usually preferable to select a plant of larger capacity and operate it only a part of the time. This is especially desirable for very small orchards in which case continuous operation gives a stream too small to irrigate with. The other disadvantages of continuous operation are:

1st. Continuous operation requires continuous irrigation and constant attention to operate the pumping plant. For very small tracts a regulating reservoir may be used, but it must be of considerable capacity to be of any service and it must be lined with concrete to prevent seepage losses of the water which when pumped is too valuable to lose. Usually it is preferable to purchase a larger plant and do without a reservoir.

2nd. Continuous operation means that the water can not be applied to the different parts of the orchard within a short time, so that only a small part of the orchard or farm receives the water when most needed, and the remainder must be irrigated either too early or too late.

3rd. Continuous operation gives a small stream which can not be applied economically.

4th. A small plant is less efficient and requires a proportionately larger fuel consumption than a larger plant to pump the same quantity of water.

On the other hand a very short period of operation requires a comparatively large pumping plant which will greatly increase the first cost of installation, the interest on the capital invested, the depreciation and fund necessary to provide for renewal.

Usually it is desirable to operate the pump not over 1-2 or 1-3 of the time during the irrigation season and often a shorter period is desirable. This requires a pumping plant two or three times or more the size required for continuous irrigation. The capacity of the pump must be sufficient in all cases to give a large enough stream to irrigate economically; even for the smallest orchards a stream of at least 5 miners' inches or about 63 U. S. gallons per minute, is desirable.

For a full bearing orchard 18 inches of irrigation water applied in about 3 irrigations of 6 inches each at intervals of 30 to 40 days should be ample in most cases. As stated above, where the water has to be pumped to a high elevation the higher cost of the water demands great care in its use and 12 to 15 inches total depth of irrigation water would be sufficient.

The table below gives the required pump capacity for various sizes of orchards or farms and for different periods of operation. It is based on a depth of irrigation water of 6 inches each month, or 18 inches in 3 months, which is taken as the irrigation season. The period of operation is given in number of 24 hour days that the pumping plant is operated each month. These days need not be consecutive; for instance if the operation period is 10 days, instead of applying 6 inches of water in one irrigation lasting 10 days, the soil may be so porous and gravelly that it will not retain moisture, in which case it may be preferable to apply 3 inches at a time in two irrigations during the month, of 5 days each. The required pump capacity is given in U. S. gallons per minute instead of Imperial gallons because the pumps sold in British Columbia are mostly rated in U. S. gallons per minute.

Necessary Capacity of Pumps in U. S. Gallons Per Minute to Give a 6 Inch Depth of Water on the Land Each Month When Operated the Following Number of 24 Hour Days Per Month.

Area Acres.	30 days.	20 days.	15 days.	10 days.	5 days.	2½ days.	1 day.
5	19	28	38	56	113	225	563
10	37.5	56.25	75	112.5	225	450	1125
15	57	85	113	170	340	675	1690
20	75	113	150	225	450	900	2250
30	113	169	225	338	675	1350	3375
40	150	225	300	450	900	1800	4500
60	226	338	450	675	1350	2700	6750
80	300	450	600	900	1800	3600	9000
120	450	675	900	1350	2700	5400	13500

The capacity of pumps for smaller or greater depths of water applied per month can be easily computed by proportion from the values given. For different areas and different periods of operation the capacity may be obtained by interpolation.

2.—Kind of Pump.

The kinds of pump commonly used to raise water for irrigation are (1)

centrifugal pumps, (2) power plunger pumps, (3) deep well pumps, (4) air lift pumps, (5) hydraulic rams.

Deep well pumps and air lift pumps are used for pumping underground water from deep wells. In British Columbia the underground water supply is unknown and need not be considered at present when the water supply is obtainable from the large streams and lakes adjacent to irrigable area. For pumping from these sources the centrifugal pumps and the power plunger pumps are the best adapted. Hydraulic rams are used for small quantities of water such as for domestic purposes or for irrigation of small pieces of land. They are economical in operation, but require special conditions such as a nearby stream with sufficient fall in a short distance. The choice between a centrifugal pump and a power plunger pump will depend on the capacity required and the height of lift.

Centrifugal pump.

A centrifugal pump consists of a circular casing with the inlet or suction end connected to the center and the outlet or discharge end formed tangent to the perimeter. Inside the casing is the runner or impeller keyed on the shaft and revolving with it. It is formed of curved vanes closely fitting the casing and corresponds to the piston or plunger of a plunger pump. When in operation the impeller by revolving imparts a velocity to the water between the vanes and forces it away from the center of the casing towards the perimeter or rim of the casing through the outlet and up the discharge pipe. This produces a partial vacuum at the center of the impeller which induces a flow through the suction pipe into the casing. The number of revolutions of the runner or speed of the pump has an exact relation to the head or lift against which the pump is working and for every head there is a speed for which the pump works most efficiently. This speed can be obtained from the pump manufacturers. It is important that the pump be connected to an engine or motor which will give it the proper speed. Overspeeding is preferable to underspeeding but either reduce the pump efficiency.

Simple centrifugal pumps specially designed and driven at a sufficiently high rate of speed may be used for lifts considerably over 100 feet, but usually the sock pump obtainable from the manufacturers is not suitable for lifts over 75 feet and for the smaller sizes the total lift should not exceed 50 feet. For higher lifts compound or multi-stage centrifugal pumps are used. These consist of two or more pumps connected in series, the discharge of the first pump or stage is delivered into the suction of the next pump and the operation is repeated according to the number of stages. Usually 75 feet to 125 feet is allowed to each stage.

Where the required capacity of the pump is over 100 or 150 gallons per minute and the total lift less than 75 feet, the centrifugal pump is no doubt the best adapted.

Centrifugal pumps are usually denoted by a number which represents the diameter of the discharge in inches. The efficient capacity of each size will vary to some extent with the speed of the pump which depends on the total lift pumped against. The pumps can, therefore, not be rated accurately. The capacities given in the accompanying table are worked out from the ratings given by a reliable pump manufacturer and are subject to considerable variations either above or below the values given.

No. of pump or diameter of discharge in inches.	Capacity in U.S. gallons per minute	Capacity in second feet or acre inch per hour.	Capacity in British Co- lumbia miners' ins.	Number of acres irrigated, 6 in. deep each month for operation period, during the month, of							
				30 days.	20 days.	15 days.	10 days.	5 days.	2½ days.	1 day.	
2	100	.22	8	27	18	13	9	4½	2¼	9-10	
2½	150	.33	12	40	27	20	13	6½	3¼	13-10	
3	225	.50	18	60	40	30	20	10	5	2	
3½	300	.66	24	80	53	40	27	13	6½	2-3	
4	400	.90	32	110	71	55	36	18	9	3-2-3	
5	700	1.60	57	190	127	95	63	32	16	6 1-3	
6	900	2.00	71	240	160	120	80	40	20	8	
7	1200	2.70	95	320	213	160	107	54	27	10 2-3	
8	1600	3.50	125	430	287	215	143	72	36	14 1-3	

To start a centrifugal pump the suction pipe and the pump must be filled with water or primed. This may be done by closing the discharge pipe with a check valve and connecting the suction end of a hand pump to the top of the casing. Where a steam engine is used a steam ejector may take the place of the hand pump. For small pumps and low lifts a foot valve on the end of the suction pipe may be used and the pump primed by pouring water in the casing, or suction pipe. The disadvantage of a foot valve is that if the water is not clear a small stone or twig may lodge itself in the foot valve and prevent priming. This will necessitate that the suction pipe be uncoupled and the obstruction removed.

The pump must be placed as near as possible to the water level to keep the suction lift down. While theoretically the suction lift may be as great as 33 feet at sea level and about 30 feet at an elevation of 3000 feet, it is desirable not to exceed 20 feet and less is preferable.

The plant efficiency can be increased by reducing the friction in the suction and discharge pipes. As few bends as possible should be used and these should be made by using long turn elbows. The suction and discharge pipes should be larger than the intake and outlet openings of the pumps and joined to the pump with an increaser. The diameter of the suction pipe and especially of the discharge pipe should be 1½ times the diameter of the intake and if the discharge pipe is long it may be economy to make its diameter even larger. Enlarging the lower end of the suction pipe will further decrease the friction. This may be done by a funnel-shaped section whose length is about 3 times the diameter of the suction pipe and whose large end is about 1½ times the diameter of the pipe. The larger opening at the entrance to the suction pipe will decrease the tendency to suck up sand or gravel. When the water carries weeds, gravel, or other material a strainer should be used and the total area of the strainer should be at least twice the area of the suction pipe. The discharge pipe should not carry the water any higher than necessary.

Power piston or plunger pumps.

This type of pump consists of one or more cylinders in each one of which a piston or plunger moving backwards and forwards sucks the water in the cylinder and forces it up the discharge pipe. When the cylinder has only one suction valve and one discharge valve the motion of the piston in one direction causes suction and displacement in the opposite direction forces the water through the discharge pipe. With two sets of valves so arranged that there is a discharge for each displacement of the piston, the

pump is known as a double acting pump. When the pump has two cylinders it is known as a duplex pump, with three cylinders it is a triplex pump, and in either case may be either double acting or single acting.

The capacity of the pump will depend on the diameter of the cylinder, the length of the stroke of the piston, and the number of strokes or revolutions per minute. The capacities of a few sizes of double acting, single piston pumps, single acting triplex pumps and of double acting duplex pumps are as follows:

Capacity of Double Acting, Single Piston Pump.

Diameter of water cylinder.	Length of stroke.	Revolutions or strokes per minute.	U. S. gallons per minute.
3 inches	5 inches	40	12.4
4	5	40	21.6
5	5	40	34
6	6	40	58
7	6	40	80
8	6	40	104

Capacity of Single Acting, Triplex Piston Pump.

3	4	50	18
4	4	50	32
4	6	50	50
5	6	50	76
5	8	45	91
6	8	45	131
7	8	45	180
7	10	42	210
8	10	40	270
8	12	40	310
9	10	40	340

Capacity of Double Acting, Duplex Pumps.

2¼	4	75	20
3	4	75	36
3½	6	60	58
4	6	60	78
5	6	60	120
6	6	60	174
5	10	50	170
6	10	50	245
7	10	50	334
8	12	50	522
9	12	50	660

The sizes of pumps and the capacities vary with the different manufacturers. The values stated above show the approximate range of the different sizes. For small capacities the double acting single piston pump may be used. For larger capacities usually the single acting triplex pump and in some cases the double acting duplex pump is used. The triplex pump is generally preferable; it has the advantage that the power is constantly applied because of the strokes overlapping and this gives an even flow with little pulsation. The suction and discharge pipe should be larger than the suction and discharge openings of the pump as for centrifugal pumps. The suction pipe should be as short as possible and the pump placed as near the water surface as possible in order to keep the suction lift low.

A plunger pump must be given proper care in order to work efficiently and keep it in working condition. It should be carefully cleaned and oiled and at the close of the pumping period it must be emptied in order that it will not be damaged by freezing and the cylinders and water passages cleaned and oiled to prevent rusting.

Choice between Centrifugal pump and power plunger pump.

The choice between a power pump and a centrifugal pump will depend on the lift and capacity.

In irrigation work power pumps are best adapted to high heads above 75 feet and to small or moderate volumes of water, usually under 200 gallons per minute. For these conditions the efficiency of a power pump is usually greater than that of a centrifugal pump. For greater volumes the plunger pumps are comparatively expensive and centrifugal pumps are usually preferable unless the lift is excessive. The centrifugal pump has the advantage that it is simple in construction with no parts to get out of order, and that it is cheaper than a power pump. The selection should be made only after careful consideration of the first cost of the pump and the annual cost of fuel, operation and maintenance. Where the lift is high the fuel cost will be considerable and it is good economy not to select the cheapest pump obtainable but one that is guaranteed for a high efficiency. On the other hand if the pump is only to be operated a very small portion of the season it would be poor economy to invest a large capital in a high grade pump to save in fuel cost.

3.—Classes of Engines or Driving Power.

Methods of connection of pump and engine.

Centrifugal pumps and power pumps are generally driven either by gasoline engines, steam engines or by electric motors. The pumps are usually either direct connected or connected by means of belts, gears or chains. Direct connection is preferable when possible, it is more economical in fuel consumption and does away with the adjustment of belt or chain necessary with belt or chain driven pumps.

The connection of the pumps and driving power must be such that the pumps will be given the speed or number of revolutions per minute for which they are designed and for which highest efficiency is obtained. For this reason direct connection can only be used where the driving power and the pump have the same speed.

The speed of centrifugal pumps is usually high and so is that of electric motors and for that reason they can, if properly designed, be direct connected; this is done usually by means of a flexible coupling. Gasoline and steam engines are generally operated at a much lower speed than centrifugal pumps and for that reason are not direct connected unless the engine and pump are specially designed. This is done by some manufacturers.

Power plunger pumps are operated at a slow speed and for that reason are not direct connected to the driving power.

When connected by gears, belts or chains the driving gear and driven gear, and the driving pulley and driven pulley must be proportioned so that the pump will be given its correct speed. When a plunger pump is built as a single machine with a steam engine, with the piston or plunger of the water cylinder on the same driving rod as the piston of the steam cylinder it is called a direct acting steam pump. The fuel consumption of a steam pump is greater than that of a steam driven power pump and for that reason steam pumps will not be considered.

Capacity of engine.

The power necessary to lift water is indicated in horse powers. A horse power represents the energy required to lift 33,000 pounds 1 foot high in one minute; this is equivalent to 3960 gallons of water per minute raised 1 foot high. This relation enables one to find the horse power required in any case by multiplying the discharge of the pump in gallons per minute by the total lift in feet and dividing by 3960. The result obtained represents the useful water horse power necessary to lift the water. The horse power delivered by the engine to the belt or gears when the pump is belted or geared to the engine, or to the pump itself when direct connected, is the brake horse power and must be greater than the useful horse power to allow for the loss of energy in the pump and transmission. The horse power developed within the engine itself is the indicated horse power and must be greater than the brake horse power to allow for the energy loss in the engine itself. Gasoline engines and motors are rated on brake horse power. Steam engines are rated on indicated horse power.

The combined efficiency of a pumping plant represents the ratio of the useful water horse power to the rated horse power of the engine, and will vary considerably with the type of pump, method of connection of engine with pump and the care taken in operating both pump and engine at the proper speed. In ordinary field practice a good pumping plant, properly installed, should easily reach the efficiency given in the following table:

Efficiency of Centrifugal Pumping Plants.

No. of centrifugal pump.	Discharge in U. S. Gallons per minute.	Water horsepower per foot of lift.	Efficiency.	Brake horsepower per foot of lift.
2	100	.025	30 per cent.	.081
2½	150	.038	35	.11
3	225	.057	40	.14
3½	300	.08	45	.18
4	400	.10	45	.22
5	700	.17	50	.34
6	900	.23	50	.46
7	1200	.31	50	.62
8	1600	.41	55	.75

The efficiency of power plunger pumps varies with the size of the pump and with the lift. A greater efficiency is obtained with the higher lifts and with the larger sizes. The efficiencies of properly installed plunger pumps and the horse power for various lifts are given in the following table:

Brake Horse Power Required to Operate Plunger Pumps.

Diameter of cylinder.	Length of stroke.	Capacity in U. S. gal. per minute.		Efficiency and Brake Horse Power for lifts of				
				50 ft.	100 ft.	150 ft.	200 ft.	250 ft.
3 inches	4 inches	18	Efficiency	.30	.40	.42	.45	.45
			Horse Power	.75	1.1	1.6	2.0	2.5
4	4	32	Efficiency	.35	.50	.60	.65	.65
			Horse Power	1.2	1.5	2.0	2.5	3.1
4	6	50	Efficiency	.35	.50	.60	.65	.65
			Horse Power	1.9	2.5	3.1	4.0	4.8
5	6	76	Efficiency	.40	.55	.65	.70	.70
			Horse Power	2.4	3.5	4.4	5.5	6.7
5	8	90	Efficiency	.40	.55	.65	.70	.72
			Horse Power	2.8	4.1	5.2	6.5	7.8
6	8	131	Efficiency	.45	.60	.65	.70	.72
			Horse Power	3.6	5.5	7.5	9.3	11.4
7	8	180	Efficiency	.45	.60	.65	.70	.72
			Horse Power	5.0	7.5	10.5	13.	15.5
7	10	210	Efficiency	.50	.65	.70	.75	.78
			Horse Power	5.25	8.0	11.	14.	17.
8	10	270	Efficiency	.50	.65	.70	.75	.78
			Horse Power	6.75	10.25	14.50	18.25	22.1
9	10	340	Efficiency	.50	.65	.70	.75	.78
			Horse Power	8.5	13.	18.	23.	28.

Type of Engine.

The above table will give the size of the engine. The driving power must be either a gasoline engine, steam engine, or electric motor. The methods of connecting the engine with the pump have been already considered. Other factors being equal, direct connection is preferable when possible. A few general considerations of the types of engine are given in the following paragraphs.

Steam Engine.

For small plants irrigating a few acres, the steam engine, although very reliable, is practically out of the question because it requires a licensed engineer whose salary would be prohibitive. However, for larger areas and where coal is cheap, it may be cheaper than either a gasoline engine or electric motor. For large plants operated continuously it may be economy to install an efficient boiler and a high grade compound condensing, triple expansion, or quadruple expansion, steam engine, in order to decrease the fuel cost. For small plants operated only for short periods during the irrigation season it is much more important to decrease the cost of installation. The interest on the capital invested and the depreciation of the plant are very important items of cost as compared to the fuel cost. For these reasons unless the acreage is large and the lift very high, the steam plant will consist of a semi-portable locomotive type boiler and an ordinary slide valve steam engine.

Gasoline Engines.

A gasoline engine is fairly reliable if it is strongly built and operated with care. Cleanliness and proper attention are necessary. All parts and bearings should be kept in fine adjustment and properly oiled, by examining the engine at least every two or three hours. The circulating water

should be kept fairly hot but not too hot. It should be nearly boiling as it comes out of the jacket.

The engine should be regulated by means of the governor to give the proper speed to the pump. To keep down the fuel consumption the gasoline feed should be so adjusted that there will be a miss in every ten or twelve explosions, and the engine should be worked up to its full rated capacity.

Over 75 per cent. of the troubles happening to gasoline engines are due to the sparking device. This can usually be remedied by cleaning all connections free from oil, scraping the ends of wires, tightening screws or replacing the batteries.

Electric Motors.

Electric motors are reliable and easy to operate, requiring very little attention.

4.—First Cost of Plant.

The first cost of a pumping plant depends on the grade of machinery, the cost of transportation, the expense of installation. Because of these factors accurate estimates of cost can not be given. However, the approximate cost values given below will be of value to the land owner who is considering the feasibility of a pumping plant. The values given represent the prices at Vancouver and do not include transportation and installation.

Approximate Cost of Single Stage Centrifugal Pumps.

No. of pump.	Capacity in U. S. gallons per minute.	Cost.
2	100	\$ 70
2½	150	85
3	225	95
3½	300	110
4	400	120
5	700	140
6	900	190
7	1200	240
8	1600	285

The cost of two step centrifugal pumps of the same sizes will be about four times the values given above.

Approximate Cost of Triplex Single Acting Power Pump.

Diameter of water cylinder.	Length of stroke in inches.	Capacity in U. S. gals. per minute.	Height of lift.	Cost.
4	8	65	75 to 100 ft.	\$ 270
5	10	130	"	400
6	12	220	"	550
4	6	48	175	300
5	8	91	"	440
7	8	180	"	600
8	10	270	"	950
8	12	310	"	1000

**Approximate Cost of Electric Motors, Gasoline Engines and Simple Slide Valve,
Non-condensing Steam Engine, With Locomotive Boiler and Auxiliaries.**

Power. Horse	Cost of electric motors. 1200 rev. per minute.	Cost of gasoline engines.	Cost of steam engines.
2	\$ 90	.....	.....
3	110	.....	.....
5	160	\$ 475	\$ 650
10	260	725	800
15	280	900	1,000
20	340	1,100	1,200
25	...	1,300	1,350
30	410	1,600	1,500
40	...	2,100	1,700

Cost of accessories and installation.

The above costs are for the pumps and engine and do not include the accessories, the foundation, the labor of installation, and the housing. For an electric plant the cost of transformers should be added unless these are supplied by the electric company. The accessories will include the suction and discharge pipes, the valves and fittings, the priming pump, the connection between pump and engine. The suction pipe is usually made of steel; the discharge pipe may be steel or wood banded pipe and should cost delivered at different points in the arid part of British Columbia about as follows:

Cost of Pipes Safe for 150 Feet Head.

Diameter of pipe.	Cost per foot of wood banded pipe.	Cost per foot of steel pipe.
4 inches	\$.20	\$.30
6	.30	.50
8	.40	.80
10	.55	1.10
12	.65	1.35
14	.75	1.60
16	.95	2.00
18	1.10	2.50
20	1.44	3.00

For a rough estimate the total cost of valves, priming pump, all fittings and suction pipe, but not discharge pipe, may be taken as about 10 per cent. of the cost of pump and engine for a gasoline or steam plant and 20 per cent. for an electric plant. The cost of installation should not exceed 5 per cent. The cost of a building to house the plant will range from about \$25 for a small plant to \$100 or more for a larger plant. The cost of transportation and hauling will depend on the railway charge from Vancouver and on the distance from the station to point of installation.

5.—Fuel Consumption and Fuel Cost.

The selection between a steam engine, gasoline engine and an electric motor will depend to some extent on the comparative cost of coal, gasoline, and electrical energy.

A gasoline engine is usually guaranteed for a fuel consumption of 1-9 to 1-10 of an Imperial gallon of gasoline per rated or brake horse power per hour. A new engine well adjusted will come up to this efficiency, but an engine that has been operated some time will consume about 1-7 of an Imperial gallon of engine gasoline or distillate per brake horse power per hour.

The fuel consumption of a steam engine will vary greatly on the type of boiler and engine. A small slide valve non-condensing engine under 25 horse power will use probably 50 to 60 pounds of steam per brake horse power per hour. A locomotive type of boiler should give 5 or 6 pounds of steam for 1 pound of coal. Therefore, a small steam engine under 25 horse power should consume about 10 pounds of coal per brake horse power per hour. Steam engines of the same type from 30 to 50 horse power will consume from 5 to 8 pounds of coal per brake horse power per hour.

Electrical energy is measured in Kilowatts. A Kilowatt is equal to 1 1-3 horse power, but because of the loss of energy in the motor, 1 Kilowatt will usually give about 1.1 brake horse power. Based on this figure 1 brake horse power hour is equal to 9-10 of a Kilowatt hour.

The above values show that to produce 1 brake horse power per hour, it requires either 1-7 of an Imperial gallon of distillate, about 10 pounds of coal, or 9-10 of a Kilowatt hour. Based on these figures the table below shows the cost of fuel per brake horse power per hour for several equivalent cost values of fuel. In the table is also given the fuel cost of pumping one acre foot of water through a lift of one foot, assuming plant efficiency of 50 per cent. and 75 per cent.

Equivalent units costs of fuel.			Fuel costs (in cents).		
Cost of gasoline in cents per Imp. gallon.	Cost of coal in dollars per ton (2,000 lb.)	Cost of electricity in cents per K. W. hour.	Per brake h. p. per hour in cents.	Per acre foot of water lifted 1 foot high.	
				50 % efficiency.	75 % efficiency.
14	\$4.00	2.25	2.0	5.5	3.65
16	4.55	2.50	2.30	6.3	4.20
18	5.15	2.85	2.55	7.0	4.70
20	5.70	3.20	2.85	7.8	5.25
22	6.30	3.50	3.15	8.65	5.75
24	6.85	3.80	3.45	9.5	6.30
26	7.40	4.15	3.70	10.20	6.80

The price of engine gasoline bought in drums is about 24 cents per gallon delivered at Kamloops and 26 cents per gallon at Okanagan points. These prices are equivalent to coal at \$6.85 to \$7.40 a ton or electricity at 3.80 to 4.15 cents a Kilowatt hour. The fuel cost is, however, only a part of the total cost of pumping.

6.—Fixed Charges and Attendance.

A.—Fixed charges.

The cost of installation represents a capital which if invested would bring in an income represented by the interest. It is therefore necessary to consider this interest as part of the cost of operation. To this should be added the annual cost of repairs, maintenance and renewal. These items of cost represent the fixed charges. After 6 or 8 years a gasoline engine may need to have its cylinder rebored and a new piston provided, the cost of which is about one-fourth the cost of a new engine. With ordinary care the life of a gasoline engine may be taken as 10 years; the life of an electric motor about 15 to 20 years. The fixed charges on the entire plant may be taken as follows:

Fixed Charges.

	Gasoline engine plant.	Electric plant.	Steam engine plant (small).
Depreciation and renewal	8 per cent.	5 per cent.	8 per cent
Repairs and maintenance	3	1	2
Interest	6	6	6
	<hr/> 17	<hr/> 12	<hr/> 16

B.—Attendance.

An electric motor requires a minimum of attendance, small gasoline plants require frequent inspection, and steam engines require a licensed engineer and for that reason can not be economically used for small plants operated during short periods. The cost of attendance for an electric motor pumping plant should not exceed 5 cents per hour, for a gasoline engine plant 10 cents per hour and for a steam engine plant 40 cents per hour. While electric motors and gasoline engines are usually operated by the orchardist or irrigator, his time is valuable and a charge should be made for it.

7.—Final Selection of Type of Plant.

The final selection of a pumping plant should be based on a careful consideration of the factors stated above. The best size of plant, the period of operation, the kind of engine or driving power, can only be correctly determined by a final consideration of cost of installation and cost of operation. For small plants operated for short periods during the irrigation season steam engines are not to be considered even where coal is cheap because they must be operated by a licensed engineer whose salary would be excessive in proportion to the saving obtained by using cheap coal. Where electric power is available the choice is between a gasoline engine and an electric motor. The electric motor requires minimum attendance, it is reliable and its first cost is much less than that of a gasoline engine. For these reasons if electric power is available, an electric motor is preferable to a gasoline engine and will prove far more economical than a gasoline, even should the cost of electrical energy be higher than the fuel cost for a gasoline engine, which is not likely to obtain in British Columbia because of the high cost of engine gasoline or distillate.

At Grand Forks, British Columbia, electricity was sold for pumping plants at the rate of 3 cents per Kilowatt hour; as far as fuel cost is concerned this is equivalent to gasoline at about 19 cents a gallon. This is less than the cost at which gasoline can be obtained and in addition gives the advantages stated above.

The application of the above information and cost data to any particular case is illustrated by the following examples:

First example: A 20 acre orchard is to be irrigated by pumping. The quantity to be applied is 6 inches per month and the total depth in one season, 18 inches. The lift is 50 feet and the discharge pipe 200 feet long. Engine gasoline costs 24 cents per Imperial gallon. Assuming the pump is operated 1-3 of the time or ten twenty-four hour days each month, this will require a pump capacity of 225 gallons per minute (page 102) which is obtained with a No. 3 centrifugal pump (page 104) and 7 horse power engine (page 107). The discharge pipe will be 4 inches in diameter. The first cost and total cost of operation will be about as follows:

First Cost of Plant.

No. 3 centrifugal pump.....	\$ 95
7 H. P. gasoline engine.....	600
Priming pump, suction pipe, fittings, etc.....	70
Freight charges and hauling.....	30
200 feet of 4 inch wood banded discharge pipe.....	80
Installation, 5% of cost.....	40
Building to house plant.....	40
Total cost	\$955

Total Annual Cost of Operation.

Fuel cost of 7 brake H. P. engine for 3 periods of 10 days each or 720 hours is equal to (page 111) 720x7x3.45—17,000c or.....	\$170
Fixed charges at 17 per cent. of first cost.....	160
Attendance 720 hours at 10 cents.....	72
Total cost for 20 acres.....	\$402
Cost per acre.....	\$20.10

Where electric power is obtainable the first cost of plant and annual cost of operation for the same conditions, assuming the unit cost of electric power to be 3 cents per Kilowatt hour would be:

First cost of plant.....	\$530.00
Total annual cost of operation.....	245.00
Cost per acre.....	12.25

Tabulated below are the first costs of gasoline engine pumping plants and the costs of operation for orchards of 20, 40 and 80 acres for lifts of 50 feet and 150 feet and for different periods of operation. For the higher lift single acting triplex pumps are used. The costs given are based on gasoline at 24 cents a gallon, for a depth of irrigation of 18 inches for the lower lift and depths of 18 inches and 12 inches for the higher lift, it being assumed that by careful use of water, if the soil is retentive, 12 inches may be sufficient. The discharge pipe is assumed to be 200 feet long.

**Cost of Pumping With Gasoline Engines and Centrifugal Pumps for 50 Foot Lift,
Gasoline 24 Cents a Gallon. ..**

Area in Acres	Number of 24 hour days pumps oper- ated monthly	Capacity of pump Gallons per minute.	Number of Pump	Horse power of engine	First cost of installation	Annual Cost of operation per acre; 18 in. depth of water applied.			
						Fuel	Fixed charges	Attendance	Total
20	5½	400	4	12	\$1,225	\$ 8.25	\$10.50	\$1.90	\$20.65
	10	225	3	7	955	8.75	8.10	3.60	20.45
	20	113	2	5	725	12.00	6.20	7.20	25.40
40	5	900	6	25	1,855	7.75	7.90	.90	16.55
	11	400	4	12	1,225	8.25	5.25	2.00	15.50
	20	225	3	7	955	8.75	4.10	3.60	16.45
80	10	900	6	25	1,855	7.75	4.00	.90	12.65
	22	400	4	12	1,225	8.25	2.60	2.00	12.85

**Cost of Pumping With Gasoline Engines and Single Acting Triplex
Pumps for 150 Foot Lift.**

Area in Acres	Number of 24 hour days pump is oper- ated monthly	Capacity of pump in gallons per minute	Horse power of engine	First cost of installation	Annual cost of operation per acre for a depth of irrigation water of				
					18 inches				of 12 inches
					Fuel	Fixed Charges	Atten- dance	Total	Total
20	8 1-3	270	15	\$2,370	\$15.50	\$20.00	\$3.00	\$38.50	\$32.30
	12 1-2	180	10	1,740	15.50	14.80	4.50	34.80	28.10
	25	90	6	1,280	18.75	10.90	9.00	38.65	29.90
40	13 1-4	340	18	2,760	15.00	11.70	2.40	29.10	23.20
	16 2-3	270	15	2,370	15.50	10.00	3.00	28.50	22.30
	25	180	10	1,740	15.60	7.40	4.50	27.50	20.80
80	26 1-2	340	18	2,760	15.00	5.85	2.40	23.25	17.35

The capacities of pumps, especially plunger pumps, and the sizes of engines, vary with the different makes, and for that reason the sizes given are not always obtainable, but sizes approximating these can be used in place.

The above cost estimates are only approximate. They are based on the conditions stated above and are not applicable to all cases because of the varying conditions which make the installation of nearly every pumping plant a special problem. The estimates are made for gasoline engines and are considerably higher than for electric motors. The first example showed that with an electric plant the cost of pumping was only 60 per cent. of the cost with a gasoline plant. The tabulated values show the following interesting results:

1st. The cost per acre of pumping is much larger for a small area than for a large area.

2nd. The cost per acre does not vary considerably with the period of operation, and in some cases a plant moderately large operating for a shorter period will cost less per acre than a smaller plant operating a longer period. This is due to the lower fuel cost obtained with the larger more efficient plant and the decreased cost of attendance for the shorter period of operation which overbalance the larger fixed charges. Even should the resulting cost be smaller for the smaller plant, the inconvenience due to pumping for a long period and the extra labor in irrigation may overbalance the saving in cost.

3rd. For the lifts assumed a period of operation equal to about ten twenty-four hour days during the month or one-third of the time during the irrigation season seems to be preferable with the centrifugal pump. With the higher price triplex plunger pumps a period of operation of one-third to two thirds of the time is preferable.

CO-OPERATIVE PUMPING.

The lower cost per acre for larger areas shows the advantages to be gained by cooperation between small owners. By uniting and installing a large plant instead of several smaller plants the cost of installation and operation is very much reduced and the plant can be given more competent attention which relieves the orchardist and increases the life of the plant.

Where by such cooperation several hundred acres can be brought together, a central steam plant to generate electric power, which is transmitted to the several electric motor pumping plants, is the most economical and best solution.

For separate plants above 20 or 40 horse power, gas producer plants connected to gas engines will furnish the cheapest power. These plants are reliable and easily operated. They consist of the producer in which hard coal is placed and through a process of partial combustion, in presence of air and steam, forms the gas which operates the engine. Gas producers operated on hard or anthracite coal have been in successful operation for a number of years and those operated on soft or bituminous coal are coming into use, but have not been very successful. The fuel consumption is very low, usually from 1 to $1\frac{1}{2}$ pounds of coal per horse power for one hour, or $\frac{1}{2}$ to $\frac{3}{4}$ of a cent. per horse power for one hour with hard coal at \$10 per ton. This is from 5 to 7 times less than the fuel cost with gasoline at 24 cents a gallon. Producer gas plants are more expensive than gasoline engines and for smaller plants the fuel economy will be overbalanced by the larger interest and depreciation charges. For very large single plants high duty steam engines will be the most economical form of installation.

LIMIT OF ECONOMICAL PUMPING.

The cases previously worked out for gasoline engine pumping plants show that for small tracts of 20 to 80 acres the cost of lifting sufficient water to give a depth of irrigation water of 18 inches will range for a lift of 50 feet from about \$12.50 per acre for the larger area to about \$20.00 per acre for the smaller area, and for lifts of 150 feet the respective costs are about \$23 and \$35 per acre. These costs may seem high as compared with gravity water, but to obtain an idea of the economy and feasibility of developing water by pumping, comparisons must be made with the value of irrigation water in the irrigated districts of British Columbia and also in other localities under the same conditions. In British Columbia, up to the present, gravity water obtainable without pumping has been quite plentiful. For that reason pumping has not been necessary, and very few pumping plants have been constructed. However, water is becoming more valuable and the steps which many irrigation companies in British Columbia are taking to conserve water and prevent losses of transportation by carrying the water in concrete lined canals and in pipes constructed at considerable expense, show that water has become sufficiently valuable to justify pumping. If a comparison is made with water thus obtained, we find that the cost of construction of a well constructed system may go up to \$50 or \$60 an acre and even higher. This cost is charged up to the land which is sold to the orchardist and in addition reasonable profit is made on the value of the land. It is probably conservative to assume that land under an irrigation system will cost at least \$100 an acre more than similar land for which there is no gravity supply. The chief advantage of gravity systems is the low annual cost of operation, usually less than \$6 per acre, but if to this be added the interest on the difference in cost between land under the irrigation system and land which is to be supplied by pumping, assumed at \$100, the total annual cost may be \$10 to \$15 an acre. This is about equal to the cost of pumping with gasoline engines to a height of 50 feet and about half as large as for lifts of 150 feet. Where electric power is available or for large pumping plants the cost of pumping would compare very favorably with gravity water even for higher lifts than those stated above. There are many contemplated hydro-electric power installations in the irrigated regions of British Co-

lumbia which, if materialized, will be of great value in extending the area irrigated by pumping.

A consideration of pumping in other districts is of interest to show its feasibility. In eastern Washington water is being pumped in one case to an elevation of 250 feet above the source of supply. In the citrus district of southern California lifts above 200 feet are not unusual and it is considered profitable to pump 460 feet. In the Pomona district of southern California, the cost of pumped water averages \$15 per acre for one acre foot when purchased from irrigation companies, while for smaller private plants the cost is often greater. In 1905 the Irrigation Investigations Office of the United States Department of Agriculture made tests on various pumping plants and these show that the cost of pumping at private plants of 10 to 100 horse power with lifts of 100 to 300 feet, varied from \$10 to \$90 per acre for one acre foot of water.

There is a limit beyond which it is not economically feasible to pump. In the California citrus districts lifts above 400 feet have been profitable. For the orchard lands of British Columbia equally high lifts should be profitable, for the net return per acre from a good apple orchard is usually more than that from a citrus orchard. A citrus orchard 10 years old should average a net profit of \$100 to \$150 per acre. The net profits from apple orchards 10 to 12 years old in the Yakima Valley are given in bulletins of the United States Department of Agriculture as \$200 to \$600 per acre. With profits larger than those obtained from citrus orchards in southern California, what has been considered feasible in pumping there is at least equally so for the apple orchards of British Columbia when no other more economical source of water supply is available. However, for small pumping plants and small areas the writer believes that it is well not to exceed 200 feet, while for larger plants lifts of 400 feet may be economically feasible.

TABLE OF CONTENTS.

	Page.
INTRODUCTION	3
I.—SELECTION OF AN IRRIGATED FARM AND SETTING OUT ORCHARDS:—	
Selection of an Orchard or Farm Under Irrigation.....	4
1. Climatic conditions	4
2. Chemical composition of the soil.....	5
3. Texture of soil and subsoil.....	5
4. Location and site of orchard.....	5
Preparation of Land for Orchard.....	6
1. Clearing the surface.....	6
2. Growing crops to improve condition of the soil.....	8
3. Locating the tree rows.....	9
II.—UNITS OF MEASUREMENT OF WATER AND METHODS OF MEASURING WATER:—	
Necessity for Knowledge of Measurement of Water.....	10
Units of Measurement.....	10
1. The cubic foot per second or second foot.....	10
2. The British Columbia miners' inch.....	11
3. Acre foot	11
4. Relation between cubic foot per second, miners' inch and acre foot	11
Methods of Measurement.....	12
1. Volumetric measurements	12
2. Weirs	13
Measurement of discharge.....	14
Weir board on a ditch.....	17
Weir box	17
3. Miners' inch board or box.....	20
Miners' inch box placed in canal or ditch.....	21
Miners' inch box and take out from pipe line under no pressure	23
Miners' inch box and take out from pressure pipe line....	24
Miners' inch box with overflow wall for canals or flumes..	24
4. Special measuring devices.....	25
The Grant-Michell meter.....	25
5. Measurement of discharge by obtaining velocity of flow and cross section of flume or canal.....	25
Current meter	27
Rating station and rating flume.....	27
Automatic registers	27
III.—CONVEYANCE OF WATER FOR THE IRRIGATION SYSTEMS OF BRITISH COLUMBIA:—	
Types of Irrigation Systems.....	29
Permanent Construction	31
Conveyance Losses of Water in Canals.....	32
1. Extent of seepage losses in canals.....	32
2. Evaporation loss from water surface of canals.....	33
Prevention of Seepage Losses in Canals.....	33
1. Concrete linings	35
Form of cross section and thickness of lining.....	35
Shrinkage and expansion.....	36
Effect of frost.....	36
Method of construction of concrete linings.....	36

TABLE OF CONTENTS—CONTINUED.

	Page.
Construction of concrete linings by means of forms...	36
Joints	38
Expansion joints	38
Method used near Kelowna by Kelowna Irrigation Company	39
Construction of concrete lining without forms	39
Cost of concrete linings	41
Cost of lining without forms	43
Economy of concrete linings	43
Steel Flumes	44
Plain Concrete Pipe Not Reinforced	45
1. Manufacturing hand tamped cement pipes	47
Mixtures used	47
Mixing materials	47
Process of moulding	47
Curing the pipe	48
Coating the pipe	48
Cost of moulds	48
Dimensions of cement pipes and rate of manufacturing ..	48
Cost of making pipe	49
2. Construction and laying of pipe line	49
Excavation of trench	49
Laying the pipe	50
3. Other methods of making cement pipe	52
Machine tamped pipe	52
Pipe made by wet process	52
Reinforced Concrete Pipe	52
1. Method of casting reinforced concrete pipe	53
(Umatilla project, Oregon.)	
2. Method of joining	54
Bell and spigot joint	54
Collar joint	54
Lock joint	54
3. Method of making and laying reinforced concrete pipe on Roswell project, Idaho	54
4. Cost of making reinforced concrete pipe	55
5. Advantages and economy of reinforced concrete pipe	56

IV.—DUTY OF WATER AND FACTORS INFLUENCING THE CORRECT USE OF WATER IN IRRIGATION:—

Duty of Water	57
1. Principal factors affecting the net duty of water	58
2. Duty of water for orchards	60
3. Duty of water for alfalfa	62
4. Duty of water for potatoes	62
Factors Influencing the Correct Use of Water in Irrigation	63
1. Disposal of water applied to the soil	63
2. Relation of soil moisture to soil texture	63
Percentage of free moisture in soil for plant growth	64
3. Evaporation of soil water and methods of checking it	65
Extent of evaporation from bare soils not cultivated	67
Effect of soil mulches on soil evaporation	68
Effect of depth of furrows on soil evaporation	68
4. Percolation of water applied to the soil	68
Effect of texture of soil and subsoil	68
Percolation of water applied in furrows	69

V.—IRRIGATION AND CULTIVATION OF ORCHARDS:—

Distribution of Water	72
1. Earthen head ditch	73

TABLE OF CONTENTS—CONTINUED.

	Page.
2. Wooden head flumes.....	76
3. Concrete head flumes.....	76
4. Cement pipes and distributing stand pipes.....	78
Details of stands.....	82
Overflow stands.....	82
Draining the pipes.....	82
Accessories.....	82
5. Pressure pipe lines and valves.....	83
6. Laying out furrows: number, length, depth and slope.....	84
Application of Water.....	85
1. When to irrigate orchards and quantity of water to use....	85
2. Number of irrigations per season.....	86
3. Fall and winter irrigation.....	87
4. Running water in the furrows.....	87
5. Prevention of losses of water applied, and cultivation.....	88

VI.—IRRIGATION OF POTATOES:—

1. Selection of soil.....	89
2. Treatment of soil.....	89
3. Planting potatoes.....	90
4. Cultivation.....	90
5. Quantity of water required for potatoes.....	90
6. Time to irrigate.....	91
7. Method of irrigation.....	92

VII.—IRRIGATION OF ALFALFA:—

1. Methods of irrigation.....	93
Furrow method of alfalfa irrigation.....	93
2. Amount of water required.....	94
3. Number of irrigations.....	97
4. The proper time to irrigate alfalfa.....	97
5. Winter irrigation of alfalfa.....	98
6. Winter killing of alfalfa.....	98
7. Seeding alfalfa on land to be irrigated.....	99

VIII.—THE USE OF SMALL PUMPING PLANTS FOR IRRIGATION IN BRITISH COLUMBIA:—

Considerations Controlling the Selection of a Pumping Plant.....	100
1. Capacity and period of operation.....	101
2. Kind of pump.....	102
Centrifugal pump.....	103
Power piston or plunger pump.....	104
Choice between centrifugal pump and power plunger pump.....	106
3. Classes of engines or driving power.....	106
Method of connection of pump and engine.....	106
Capacity of engine.....	107
Type of engine.....	108
Steam engine.....	108
Gasoline engine.....	108
Electric motors.....	109
4. First cost of plant.....	109
Cost of accessories and installation.....	110
5. Fuel consumption and fuel cost.....	110
6. Fixed charges and attendance.....	111
(a) Fixed charges.....	111
(b) Attendance.....	112
7. Final selection of type of plant.....	112
Cooperative Pumping.....	114
Limit of Economical Pumping.....	115

PROVINCE OF BRITISH COLUMBIA.

DEPARTMENT OF AGRICULTURE
(STATISTICS BRANCH).

AGRICULTURAL STATISTICS, 1911.

BULLETIN No. 43.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

*PRINTED BY AUTHORITY OF
THE LEGISLATIVE ASSEMBLY OF BRITISH COLUMBIA.*

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.

1912.

PROVINCE OF BRITISH COLUMBIA.

DEPARTMENT OF AGRICULTURE
(STATISTICS BRANCH).

AGRICULTURAL STATISTICS, 1911.

BULLETIN No. 43.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

*PRINTED BY AUTHORITY OF
THE LEGISLATIVE ASSEMBLY OF BRITISH COLUMBIA.*

VICTORIA, B.C. :
Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1912.

DEPARTMENT OF AGRICULTURE,

VICTORIA, B.C., 29th April, 1912.

The Hon. Price Ellison,

Minister of Finance and Agriculture.

SIR,—I have the honour to submit herewith Bulletin No. 45, dealing with the general conditions of the crops, etc., throughout British Columbia in 1911, as compiled in the Statistics Branch of the Department of Agriculture.

I have the honour to be,

Sir,

Your obedient servant,

WM. E. SCOTT,

Deputy Minister of Agriculture.

INTRODUCTION.

The collection of statistics relating to the acreage of the various crops, number of live-stock, and the general resources of the Province of British Columbia has been a branch of work in the Department of Agriculture that for some years past has not received the attention which it justly deserved; however, this bulletin is now the advent of the reorganization of the Statistics Branch. It is the intention of the Department to issue periodically crop reports dealing with the prevailing conditions, obtaining at the same time the market prices, and generally such information as will be of great interest and paramount importance towards the advancement of agricultural affairs in the Province.

Last year 221 correspondents were enrolled throughout the Province, who voluntarily give their services in compiling reports dealing with the estimated yield, and subsequently with the estimated acreage and actual yield, of the different crops throughout the specified districts. The services of the correspondents have been appreciated, and their support all round has been very generous.

At the present time the Statistics Branch is undergoing a remodelling process, and it is anticipated that the scheme at present under consideration, if put into force, will prove the one most likely to give the best satisfaction in regard to the obtaining of information from farmers throughout the districts as affecting the condition of their crops, together with prospects of harvest returns.

The information as herein embodied will help to give the general public interested in the development of the Province of British Columbia an idea as to its potentialities, general resources, and great possibilities in regard to the productiveness of the land.

In this bulletin I have divided the Province into groups as follows:—

- (1.) Islands, comprising the Districts of Alberni, Comox, Cowichan, Nanaimo, Victoria, and the Gulf Islands:
- (2.) Lower Mainland, comprising the New Westminster and Delta Districts:
- (3.) Thompson River Watershed, comprising the Districts of Ashcroft, Kamloops, and Nicola:
- (4.) Northern British Columbia, comprising the Districts of Atlin, Cariboo, Clinton, Hazelton, Peace River (Fort St. John), Skeena, and Stikine:
- (5.) Dry Belt and Boundary Districts, comprising the Districts of Okanagan, Fairview, Grand Forks, and Greenwood:
- (6.) Eastern and Western Kootenays, comprising the Districts of Revelstoke, Kaslo, Golden, Cranbrook, Rossland, and Fernie.

The statistical tables give information as to the actual state of affairs with regard to the crop production in each specified district as grouped under above headings, and in continuity will be found tables giving the average prices. The agricultural resources of the Province are also shown as a whole, together with the estimated value of products during 1911.

In these days of rapid development and the necessity of complete transportation throughout all parts of a producing area, it is highly essential

that statistics relating to the supply of human food should be as trustworthy as practical results and most modern methods can make them. Varying changes have taken place regarding the economic conditions prevailing throughout the world during the nineteenth century, and in the Dominion of Canada, and more especially in the Province of British Columbia, the economic revolution is still in progress. Everybody is interested in the wealth and resources of the Province, no matter in what walk of life their duties lie, and the information such as it is hoped will be obtained and disseminated from time to time by the Statistics Branch will be of paramount importance to the public at large, though more especially so to the agricultural community.

ALBERT E. CRADDOCK,
Secretary and Statistician.

AGRICULTURAL STATISTICS, 1911.

CLIMATIC CONDITIONS.

THE winter of 1910-11 was visited by a heavy snowfall, which provided ample water for irrigation purposes where necessary. The spring was normal as to time, but in certain fruit-sections the heavy spring frosts injured the blossoms somewhat.

The early summer in the Dry Belt was marked by coolness and unusual precipitation, which aided materially in the production of a very large crop, especially so in vegetables.

The climatic conditions were similar in the Kootenays, whilst on the Lower Mainland, where the spring was backward, a warm, dry summer followed.

On Vancouver Island and throughout the Gulf Islands the summer was an unusually dry one, vegetables and fruit suffering to some extent. The fall was exceptionally fine and very favourable to the harvesters.

At all interior points throughout the Mainland the month of October proved very dry, and the first general snowfall, with low temperatures following, occurred throughout the Province towards the end of this month and the beginning of November.

NOTE.—Where it has been deemed worthy of special note to comment upon a particular item or return dealing with the crop reports in any district, mention is made accordingly.

MIXED FARMING.

GRAIN, HAY, ROOTS, AND LIVE-STOCK.

GROUP No. 1—ISLANDS.

	Area in Crop. Acres.	Average Yield.	Total Yield.
<i>Alberni District.</i>			
Wheat	34½	25.0 bus.	862 bus.
Oats	343	40.5 „	13,920 „
Barley	5¼	29.9 „	157 „
Hay	1,223	1.9 tons	2,421 tons
Potatoes	48½	5.8 „	285½ „
Other crops	32	5.7 „	184 „
Market-garden crops	14	12.2 „	172 „

GROUP No. 1—*Continued.*

	Area in Crop. Acres.	Average Yield.	Total Yield.
<i>Comox District.</i>			
Wheat	109½	33.7 bus.	3,694 bus.
Oats	895	45.8 "	41,024 "
Barley	3	30.0 "	90 "
Grain hay	76	2.0 tons	152 tons
Hay	2,374½	2.1 "	5,159 "
Potatoes	154½	6.5 "	1,007½ "
Other crops	176¼	12.6 "	2,233 "
Market-garden crops	80½	11.0 "	886 "
<i>Cowichan District.</i>			
Wheat	107¼	29.5 bus.	3,157 bus.
Oats	570	41.7 "	23,770 "
Barley	0½	30.0 "	15 "
Rye	1	24.0 "	24 "
Hay	156	2.0 tons	1,755 tons
Potatoes	109	5.9 "	652 "
Other root crops	58	9.7 "	572 "
Other crops	81	10.1 "	822 "
Market-garden crops	22	12.0 "	264 "
<i>Nanaimo District.</i>			
Wheat	147	27.6 bus.	4,062 bus.
Oats	326	53.1 "	17,320 "
Barley	33	30.0 "	990 "
Hay	1,318	2.2 tons	2,922 tons
Potatoes	98½	6.2 "	619 "
Other crops	151	13.3 "	2,013 "
Market-garden crops	25	12.0 "	300 "
<i>Victoria and Gulf Islands District.</i>			
Wheat	1,122	38.3 bus.	43,033 bus.
Oats	1,165	39.3 "	45,796 "
Barley	51	30.2 "	1,540 "
Rye	13	24.0 "	312 "
Grain hay	110	2.0 tons	220 tons
Hay	2,346	2.2 "	5,392 "
Potatoes	618	6.3 "	3,931 "
Other root-crops	65	4.2 "	278 "
Other crops	290	9.7 "	2,827 "
Market-garden crops	193	12.0 "	2,325 "

GROUP No. 1—*Concluded.*

SUMMARY OF GROUP No. 1.

	Area in Crop. Acres.	Average Yield.	Total Yield.
Wheat	1,520 $\frac{1}{4}$	36.0 bus.	54,808 bus.
Oats	3,299	43.0 „	141,830 „
Barley	92 $\frac{3}{4}$	30.1 „	2,792 „
Rye	14	24.0 „	336 „
Grain hay	186	2.0 tons	372 tons
Hay	9,673 $\frac{1}{2}$	2.1 „	20,778 „
Potatoes	1,028 $\frac{1}{2}$	6.3 „	6,495 „
Other root-crops	123	6.9 „	850 „
Other crops	730 $\frac{1}{4}$	11.0 „	8,079 „
Market-garden crops	334 $\frac{1}{2}$	11.8 „	3,947 „

This group shows the third highest average production per acre in oats (43 bushels) and the second in wheat (36 bushels) in the Province.

Taking the Islands generally, the hay-crop was better than that of 1910; grain, other than oats and wheat, previously mentioned, showing a good average production.

June frosts in many districts cut down potatoes and lowered the average yield. Roots and market-garden crops show a high average.

Live-stock.

Beef cattle	1,693
Dairy cattle	3,738
Horses	4,785
Sheep	5,586
Swine	4,736

	Acres.
Acreege of land under grasses	9,673 $\frac{1}{2}$
Acreege of land cleared	2,033
Acreege of land in crop—grain, fruit, etc.	5,554 $\frac{1}{4}$
Acreege of grazing land, including bush	49,045*

GROUP No. 2—LOWER MAINLAND.

New Westminster, Delta, etc.	Area in Crop. Acres.	Average Yield.	Total Yield.
Wheat	1,007	36.8 bus.	37,070 bus.
Oats	23,354	55.9 „	1,307,176 „
Barley	628	49.2 „	30,900 „
Rye	24	40.0 „	960 „
Hops	320	1,500 lb.	480,000 lb.
Hay	38,961	2.1 tons	81,959 tons
Potatoes	4,814	6.6 „	32,210 „
Other root-crops	878	12.0 „	10,536 „
Market-garden crops	1,718	12.0 „	20,616 „

* According to actual returns received, though not to be taken as a complete record of all grazing lands in the group.

Fall wheat, oats, barley, and rye do remarkably well in this group of districts, all these varieties of grain showing the highest average production in the Province.

Hay, roots, market-garden crops, and hops also show a very high average.

Live-stock.

Beef cattle	254
Dairy cattle	4,559
Horses	12,140
Sheep	1,640
Swine	860

	Acres.
Acreage of land under grasses	38,961
Acreage of land cleared	3,500
Acreage of land in crop—grain, fruit, etc.	34,483
Acreage of grazing land, including bush	47,498
(See note after summary, Group No. 1, <i>re</i> grazing land.)	

GROUP NO. 3—THOMPSON RIVER WATERSHED.

	Area in Crop. Acres.	Average Yield.	Total Yield.
<i>Ashcroft District.</i>			
Wheat	1,541	20.0 bus.	30,890 bus.
Oats	1,411½	33.6 „	47,505 „
Barley	525	30.0 „	15,750 „
Hops	1	500 lb.	500 lb.
Grain hay	24	1.5 tons	36 tons
Hay	10,542	2.2 „	23,660½ „
Potatoes	907	8.9 „	8,142 „
Other crops	1,451½	4.6 „	6,676½ „
Market-garden crops	192½	12.0 „	2,310 „
<i>Kamloops District.</i>			
Wheat	515	36.0 bus.	18,540 bus.
Oats	10	40.0 „	400 „
Barley	50	30.0 „	1,500 „
Hay	1,783	2.8 tons	5,149 tons
Potatoes	131½	6.0 „	789 „
Other root-crops	3	5.0 „	15 „
Other crops	52	12.0 „	624 „
Market-garden crops	4	12.0 „	48 „
<i>Nicola District.</i>			
Wheat	192	30.4 bus.	5,849 bus.
Oats	937	41.2 „	38,625 „
Barley	78	30.3 „	2,343 „
Grain hay	24	1.5 tons	36 tons
Hay	7,979	1.9 „	15,563 „
Potatoes	89	6.2 „	556 „
Market-garden crops	11¼	11.4 „	129 „

GROUP No. 3—*Concluded.*

SUMMARY OF GROUP No. 3.

	Area in Crop. Acres.	Average Yield.	Total Yield.
Wheat	2,248	24.5 bus.	55,279 bus.
Oats	2,358½	36.9 „	86,530 „
Barley	653	36.6 „	19,593 „
Hops	1	500 lb.	500 lb.
Grain hay	24	1.5 tons	36 tons
Hay	20,304	2.1 „	44,372½ „
Potatoes	1,127½	8.4 „	9,487 „
Other root crops	3	5.0 „	15 „
Other crops	1,503½	4.8 „	7,300½ „
Market-garden crops	207¾	11.9 „	2,487 „

Grain-crops show a very fair average in this group. Alfalfa is a profitable crop, and should be more extensively grown.

The average production of potatoes (8.4 tons per acre) is the highest in the Province, the Ashcroft District itself showing an average of 8.9 tons per acre.

Market-garden crops also show a heavy production. Beans and corn pay well.

Live-stock.

Beef cattle	15,138
Dairy cattle	1,030
Horses	4,128
Sheep	3,448
Swine	2,311

	Acres.
Acreage of land under grasses	20,304
Acreage of land cleared	4,985
Acreage of grazing land, including bush	206,531
(See note after summary, Group No. 1, <i>re</i> grazing land.)	

GROUP No. 4—NORTHERN BRITISH COLUMBIA.

	Area in Crop Acres.	Average Yield.	Total Yield.
<i>Atlin District.</i>			
Grain hay	13	1.5 tons	19½ tons
Hay	101	1.0 „	101 „
Market-garden crops	8½	5.6 „	48 „

GROUP No. 4—Continued.

	Area in Crop. Acres.	Average Yield.	Total Yield.
<i>Cariboo District.</i>			
Wheat	510	22.3 bus.	11,414 bus.
Oats	2,207	39.2 "	87,707 "
Barley	102	29.3 "	2,990 "
Rye	43	10.0 "	430 "
Hay	3,937	1.4 tons	5,687½ tons
Potatoes	176	6.4 "	1,126¾ "
Other root-crops	18	11.6 "	210 "
Market-garden crops	35	9.2 "	324 "
<i>Clinton District.</i>			
Oats	21	38.7 bus.	814 bus.
Barley	0½	40.0 "	20 "
Rye	10	10.0 "	100 "
Hay	2,933	2.0 tons	5,866 tons
Potatoes	4	1.5 "	6 "
Other root-crops	8	9.0 "	72 "
Market-garden crops	16	12.0 "	192 "
<i>Hazelton District.</i>			
Oats	450	60.0 bus.	27,000 bus.
Barley	30	30.0 "	900 "
Hay	7,500	1.4 tons	11,200 tons
Potatoes	75	5.0 "	375 "
Other root-crops	60	8.0 "	480 "
Market-garden crops	60	8.0 "	480 "
<i>Peace River District (Fort St. John).</i>			
Oats (cut for hay), barley, etc.	51	2.0 tons	102 tons
Hay	150	1.3 "	200 "
Potatoes	4	5.0 "	20 "
Other root-crops	1½	10.0 "	15 "
Other crops	3	1.0 "	3 "
<i>Skeena River District.</i>			
Wheat	2	15.0 bus.	30 bus.
Oats	63¼	60.2 "	3,795 "
Barley	1	15.0 "	30 "
Hay	668½	2.3 tons	1,589 tons
Potatoes	63	6.5 "	410 "
Market-garden crops	9½	12.0 "	114 "
<i>Stikine River District.</i>			
Grain hay	22	2.0 tons	44 tons
Hay	80	2.0 "	160 "
Potatoes	1	6.0 "	6 "

GROUP No. 4—*Concluded.*

SUMMARY OF GROUP No. 4.

	Area in Crop. Acres.	Average Yield.	Total Yield.
Wheat	517	22.1 bus.	11,444 bus.
Oats	2,741 $\frac{1}{4}$	43.5 "	119,316 "
Barley	184 $\frac{1}{2}$	21.9 "	4,042 "
Rye	53	10.0 "	530 "
Grain hay	35	1.8 tons	63 $\frac{1}{2}$ tons
Hay	15,369 $\frac{1}{2}$	1.6 "	24,803 $\frac{1}{2}$ "
Potatoes	323	6.0 "	1,943 $\frac{3}{4}$ "
Other root-crops	88	8.8 "	778 $\frac{1}{2}$ "
Other crops	3	1.0 "	3 "
Market-garden crops	129	8.9 "	1,158 "

The spring was dry and cold, with an average rainfall in summer, which was followed by an exceptionally fine fall.

The averages for yield of oats in the Hazelton and Skeena River Districts are amongst the highest in the Province.

Oat straw was short in some districts.

The hay-crop was good generally, in places a heavy second crop being cut, the hay curing well.

Market-garden produce in many districts proved a partial failure owing to the ravages of cutworms, and the early, dry, cold season.

The foregoing figures show conclusively that large quantities of agricultural products have to be imported into the territory encompassed in Group No. 4, and the table of prices in this bulletin will convey immediately to the lay mind the possibilities there are for further increased development in order that a supply may be provided locally equal to the demand.

Live-stock.

Beef cattle	11,932
Dairy cattle	584
Horses	3,537
Sheep	1,395
Swine	946
	Acres.
Acreage of land under grasses	15,369 $\frac{1}{2}$
Acreage of land cleared	2,705
Acreage of land in crop—grain, fruit, etc.	4,127 $\frac{1}{4}$
Acreage of grazing land, including bush	182,649
(See note after summary, Group No. 1, <i>re</i> grazing land.)	

GROUP NO. 5.—DRY BELT AND BOUNDARY DISTRICTS.

	Area in Crop. Acres.	Average Yield.	Total Yield.
<i>Okanagan District.</i>			
Wheat	6,653½	28.8 bus.	191,983 bus.
Oats	4,040	44.1 "	178,189 "
Barley	457	37.6 "	17,212 "
Rye	7	25.0 "	175 "
Hops	45	844 lb.	38,000 lb.
Grain hay	717	1.8 tons	1,347 tons
Hay	13,219½	2.2 "	29,075 "
Potatoes	2,765½	7.9 "	21,992 "
Other root-crops	81	14.7 "	1,198 "
Other crops	410	14.0 "	5,760 "
Market-garden crops	875¾	12.8 "	11,227¾ "
<i>Fairview District.</i>			
Wheat	288	36.7 bus.	10,570 bus.
Oats	413	52.3 "	21,635 "
Barley	45	50.0 "	2,250 "
Grain hay	91	1.4 tons	129 tons
Hay	2,141	2.1 "	4,546 "
Potatoes	79	5.9 "	470 "
Other root-crops	5	12.0 "	60 "
Other crops	20	12.0 "	240 "
Market-garden crops	15	1.7 "	110 "
<i>Grand Forks District.</i>			
Wheat	325	31.4 bus.	10,310 bus.
Oats	759	30.0 "	37,950 "
Barley	55	40.0 "	2,200 "
Grain hay	148	2.0 "	296 "
Hay	220	2.3 tons	510 tons
Potatoes	623	6.0 "	3,791 "
Other crops	184½	13.5 "	2,474 "
Market-garden crops	163½	9.6 "	1,562 "
<i>Greenwood District.</i>			
Wheat	1,637	27.9 bus.	45,820 bus.
Oats	1,134	35.3 "	40,065 "
Barley	27	29.6 "	800 "
Rye	60	25.0 "	1,500 "
Grain hay	15	3.0 tons	45 tons
Hay	2,132	1.5 "	3,379 "
Potatoes	189	5.0 "	955 "
Other root-crops	17	11.7 "	200 "
Other crops	26	11.5 "	300 "
Market-garden crops	27	12.0 "	324 "

GROUP NO. 5—*Concluded.*

SUMMARY OF GROUP NO. 5.

	Area in Crop. Acres.	Average Yield.	Total Yield.	
Wheat	8,903½	29.0 bus.	258,683	bus.
Oats	6,346	43.7 „	277,839	„
Barley	584	38.4 „	22,462	„
Rye	67	25.0 „	1,675	„
Hops	45	844 lb.	38,000	lb.
Grain hay	971	1.8 tons	1,817	tons
Hay	17,712½	2.1 „	37,510	„
Potatoes	3,656½	7.4 „	27,208	„
Other root-crops	103	14.1 „	1,458	„
Other crops	640½	13.6 „	8,774	„
Market-garden crops	1,081¼	12.2 „	13,223¾	„

In the Northern Okanagan fall wheat was good and spring wheat light; oats and barley good; a considerable amount of grain being cut for hay.

Potatoes and sugar-beets were a very good crop in this section also.

In the Southern Okanagan, to the boundary, potatoes were light. In the Greenwood District grain-crops were good, roots particularly so. At Grand Forks the season was a good one, especially for potatoes and truck-crops.

The figure for oats (43.7 bushels per acre) is the third best average in this Province, and for barley (38.4 bushels per acre) is the second best.

Roots at an average of 14.1 tons per acre and market-garden crops at 12.2 tons an acre are the highest in the Province.

Potatoes at 7.4 tons per acre being the second highest average for same.

The crop of hops in the Okanagan was good, but owing to labour difficulties it was picked late and some waste occurred, thus affecting the average yield.

Live-stock.

Beef cattle	9,746
Dairy cattle	1,711
Horses	7,022
Sheep	4,952
Swine	4,162

	Acres.
Acreage of land under grasses	17,712½
Acreage of land cleared	21,368
Acreage of land in crop—grain, fruit, etc.	46,064
Acreage of grazing land, including bush	253,807
(See note after summary, Group No. 1, <i>re</i> grazing land.)	

GROUP NO. 6.—EAST AND WEST KOOTENAYS.

	Area in Crop. Acres.	Average Yield.	Total Yield.
<i>Revelstoke District.</i>			
Wheat	19	14.7 bus.	280 bus.
Oats	93	25.0 "	2,325 "
Barley	7½	10.0 "	75 "
Rye	0½	12.0 "	6 "
Grain hay	19½	2.0 tons	39 tons
Hay	1,693½	2.1 "	3,566 "
Potatoes	129½	6.4 "	839 "
Other root-crops	4	12.0 "	48 "
Other crops	4	12.0 "	48 "
Market-garden crops	73	12.0 "	876 "
<i>Kaslo District.</i>			
Wheat	35	28.8 bus.	1,010 bus.
Oats	22½	57.6 "	1,297 "
Hay	861¾	2.1 tons	1,818½ tons
Potatoes	295½	4.9 "	1,467 "
Other root-crops	2	12.0 "	24 "
Other crops	10	6.5 "	65 "
Market-garden crops	37¾	10.2 "	378¾ "
<i>Golden District.</i>			
Wheat	54	31.9 bus.	1,727 bus.
Oats	57	40.7 "	2,322 "
Barley	7	22.0 "	154 "
Flax	3	13.5 "	40½ "
Grain hay	93	2.1 tons	197½ tons
Hay	282	2.0 "	564 "
Potatoes	8	9.0 "	72 "
Other crops	3	12.0 "	36 "
Market-garden crops	2	12.0 "	24 "
<i>Cranbrook District.</i>			
Wheat	88½	24.9 bus.	2,212 bus.
Oats	218	40.4 "	8,820 "
Barley	6	40.0 "	240 "
Rye	54	24.1 "	1,306 "
Hay	764	2.2 tons	1,697 tons
Potatoes	63½	4.0 "	258½ "
Other crops	6	12.5 "	76 "
Market-garden crops	31½	11.6 "	366 "

GROUP No. 6—*Concluded.*

	Area in Crop. Acres.	Average Yield.	Total Yield.
<i>Rossland District.</i>			
Wheat	2	25.0 bus.	50 bus.
Oats	1½	62.3 "	93 "
Barley	3½	23.1 "	81 "
Rye	4	3.0 "	12 "
Grain hay	55¾	2.0 tons	111½ tons
Hay	771¾	1.9 "	1,469¼ "
Potatoes	39	4.6 "	181 "
Other root-crops	16	4.0 "	64 "
Other crops	4½	14.0 "	63 "
Market-garden crops	163	2.2 "	363 "
<i>Fernie District.</i>			
Wheat	76	30.8 bus.	2,346 bus.
Oats	70	36.8 "	2,581 "
Barley	14	31.7 "	444 "
Rye	5	50.0 "	250 "
Grain hay	54½	2.7 tons	148 tons
Hay	1,219½	1.8 "	2,275¾ "
Potatoes	124½	4.0 "	502 "
Other crops	15½	7.4 "	116 "
Market-garden crops	66¾	7.9 "	531 "

SUMMARY OF GROUP NO. 6.

	Area in Crop. Acres.	Average Yield.	Total Yield.
Wheat	274½	27.7 bus.	7,625 bus.
Oats	462	37.7 "	17,438 "
Barley	38	26.1 "	994 "
Rye	63½	24.7 "	1,574 "
Flax	3	13.5 "	40½ "
Grain hay	222¾	2.2 tons	496 tons
Hay	5,592½	2.0 "	11,390½ "
Potatoes	660	5.2 "	3,319½ "
Other root-crops	22	6.1 "	136 "
Other crops	43	9.3 "	404 "
Market-garden crops	374	6.7 "	2,538¾ "

This is a widely scattered section with varying conditions, a medium position being held as regards grain averages. The areas under cultivation are limited. In the northern section grain was mostly cut for hay; alfalfa was poor, potatoes and roots were good, the former running up to 8 tons per acre in some districts; speculation is affecting agricultural interests in the Golden District.

In the Kaslo District oats and hay crops were heavy and vegetables were of fine quality, with a strong local demand.

In the southern section, also, grain was largely cut for hay; barley up to 40 bushels per acre and oats up to 110 bushels per acre being produced in individual cases; hay-crops were heavy and roots fair. Hops grow well in the Cranbrook District, but are very little cultivated.

Live-stock.

Beef cattle	1,565
Dairy cattle	891
Horses	4,227
Sheep	923
Swine	1,382

	Acres.
Acreage of land under grasses	5,592½
Acreage of land cleared	2,085
Acreage of land in crop—grain, fruit, etc.	4,209½
Acreage of grazing land, including bush	87,001
(See note after summary, Group No. 1, <i>re</i> grazing land.)	

RECAPITULATION.

	Area in Crop Acres.	Average Yield.	Total Yield.
Wheat.	14,470¼	29.3 bus.	424,909 bus.
Oats	38,560¾	50.5 "	1,950,129 "
Barley	2,180¼	37.0 "	80,783 "
Rye	236½	21.6 "	5,105 "
Flax	3	13.5 "	40½ "
Hops	366	1,416.6 lb.	518,500 lb.
Grain hay	1,438¾	1.9 tons	2,784½ tons
Hay	107,613	2.0 "	220,813½ "
Potatoes	11,609½	6.9 "	80,663¼ "
Other root-crops	1,217	11.3 "	13,773½ "
Other crops	2,920¼	8.0 "	24,560½ "
Market-garden crops	3,844½	11.4 "	43,970½ "

Live-stock.

Beef cattle	40,328
Dairy cattle	12,513
Horses	35,839
Sheep	17,944
Swine	14,398

	Acres.
Acreage of land under grass	107,613
Acreage of land cleared	36,676
Acreage of land in crop—grain, fruit, etc.	108,665¾
Acreage of grazing land (from partial returns), including bush	826,531

	Wheat. Bushels.	Oats. Bushels.	Barley. Bushels.	Rye. Bushels.	Flax. Bushels.	Hops. Lb.	Grain Hay. Tons.	Hay. Tons.	Potatoes. Tons.	Other crops. Tons.	Other Crops. Tons.	Market- garden Crops. Tons.
GROUP NO. 1.												
Victoria and Gulf Islands	38.3	39.3	30.2	24.0	...	...	2.0	2.2	6.3	4.2	9.7	12.0
Alberni	23.0	40.5	29.9	...	...	...	...	1.9	5.8	...	5.7	12.2
Comox	33.7	45.8	30.0	...	...	...	2.0	2.1	6.5	...	12.6	11.0
Cowichan	29.5	41.7	30.0	24.0	...	...	...	2.0	5.9	9.7	10.1	12.0
Nanaimo	27.6	53.1	30.0	...	...	...	...	2.2	6.2	...	13.3	12.0
GROUP NO. 2.												
Lower Mainland	36.8	55.9	49.2	40	...	1,500	...	2.1	6.6	12.0	...	12.0
GROUP NO. 3.												
Ashcroft	20.0	33.6	30.0	...	...	500	1.5	2.2	8.9	...	4.6	12.0
Kamloops	36.0	40.0	30.0	...	...	...	...	2.8	6.0	5	12.0	12.0
Nicola	30.4	41.2	30.3	...	...	...	...	1.9	6.2	...	...	11.4
GROUP NO. 4.												
Atlin	...	...	...	...	...	...	1.5	1.0	...	11.6	3.0	5.6
Cariboo	22.3	39.2	29.3	10.0	...	...	...	1.4	6.4	...	...	9.2
Clinton	...	38.7	40.0	10.0	...	...	...	2.0	1.5	9	...	12.0
Hazelton	...	60.0	30.0	...	...	...	...	1.4	5.0	8.0	...	8.0
Peace River	...	...	...	...	...	...	2.0	1.3	5	10.0	1.0	...
Skeena	15.0	60.2	15.0	...	...	...	...	2.3	6.5	...	...	12.0
Stikine	...	...	...	...	...	...	2.0	2.0	6.0	...	...	...
GROUP NO. 5.												
Fairview	36.7	52.3	50.0	...	...	...	1.4	2.1	5.9	12.0	12.0	7.7
Grand Forks	31.4	30.0	40.0	...	...	...	2.0	2.3	6.0	13.5	...	9.6
Greenwood	27.9	35.3	29.6	25.0	...	844	3.0	1.5	5.0	11.7	13.5	12.0
Okanagan	28.8	44.1	37.6	25.0	...	...	1.8	2.2	7.9	14.7	14.0	12.8
GROUP NO. 6.												
Revelstoke	14.7	25.0	10.0	12.0	...	...	2.0	2.1	6.4	12.0	12.0	12.0
Kaslo	28.8	57.6	...	...	...	...	...	2.1	4.9	12.0	6.5	10.2
Golden	31.9	40.7	22.0	...	13.5	...	2.1	2.0	9.0	...	12.0	12.0
Crabbrook	24.9	40.4	40.0	24.1	...	...	...	2.2	4.0	...	12.5	11.6
Rossland	25.0	62.3	23.1	3.0	...	...	2.0	1.9	4.6	4.0	14.0	...
Fernie	30.8	36.8	31.7	50.0	...	...	2.7	1.8	4.0	...	7.4	7.9
Province	29.3	50.5	37.0	21.6	13.5	1,416.6	1.9	2.0	6.9	11.3	8.0	11.4

YEAR 1911
AVERAGE PRODUCTION PER ACRE
OF POTATOES, ROOTS & MARKET GARDEN CROPS
BRITISH COLUMBIA

SUMMARY OF CROPS AND STOCK, INCLUDING PERMANENT

GROUP.	GRAIN.		OTHER CROPS.		H
	Bushels.	Value.	Tons.	Value.	Tons.
(1.) Islands	199,766	\$ 193,233	..	..	21,150
(2.) Lower Mainland	1,376,106	1,080,917	240	\$192,000	81,959
(3.) Thompson River Watershed ...	161,432	132,157	$\frac{1}{4}$	200	44,408 $\frac{1}{2}$
(4.) Northern	135,332	221,227	..	..	24,867
(5.) Dry Belt and Boundary	560,659	498,385	19	15,200	39,327
(6.) East and West Kootenays	27,631	28,921	40 bus.	80	11,886 $\frac{1}{2}$
Total	2,460,926	\$2,160,327	259 $\frac{1}{4}$ tons. 40 bus.	\$207,480	223,597

N.B.—Group values estimated at average rates prevailing in each district. Totals valued at average rates as the northern district of the Province exceeds very much the proportionate values obtainable in other districts.

PERMANENT STOCK, IN BRITISH COLUMBIA, WITH VALUES.

HAY.		FRUIT AND SMALL FRUITS.			VEGETABLES.	
Tons.	Value.	Boxes.	Crates.	Total Value.	Tons.	Value.
21,150	\$ 423,000	32,962	96,169	\$270,581	19,371	\$ 369,500
81,959	1,372,813	11,200	3,150	22,407	63,362	1,226,300
44,408½	843,797	7,862	1,696	18,196	19,289½	456,430
24,867	871,368	100	1,601	5,756	3,883½	243,870
39,327	782,906	232,762	54,022	499,723	50,663½	1,196,170
11,886½	250,112	19,054	21,497	96,113	6,398½	187,980
223,597	\$4,913,566	303,940	178,135	\$878,181	162,966	\$4,206,060

valued at average prices for the whole Province. This basis of computation has been invariable in other districts, mainly owing to present lack of transportation facilities.

AVERAGE PRICES BASED ON CROP CORRESPONDENT'S RETURNS IN 1911.

Crop.	GROUP NO. 1. Islands.	GROUP NO. 2. Lower Main- land.	GROUP NO. 3. Thompson River Water- shed.	GROUP NO. 4. Northern.	GROUP NO. 5. Dry Belt.	GROUP NO. 6. East and West Kootenays.
Wheat	\$ 1 40	\$ 1 40	\$ 1 10	\$ 2 17	\$ 1 18	\$ 1 42
Oats	80	77	60	1 59	63	84
Barley	98	70	69	1 26	75	1 41
Rye	90	90	1 20	3 00	75	1 30
Grain Hay	20 00	16 75	20 00	51 12	18 00	22 16
Hay (clover and timothy)	20 00	2 00	19 00	35 29	20 00	21 15
Flax	..	2 00	..	..	..	..
Hops	..	40	..	..	..	..
Apples	1 75	1 50	1 87	3 00	..	..
Pears	1 85	1 62	2 40	..	1 55	2 17
Cherries (sour)	2 75	2 60	2 70	..	1 89	2 55
Cherries (sweet)	1 11	1 00	1 00	..	2 12	2 32
"	2 00	..	..	..	1 22	93
Apricots	2 90	95	..	..	2 00	83
Plums and prunes	1 83	..	1 90	..	83	1 17
Peaches	1 80	1 70	2 00	3 00	1 07	1 55
Raspberries	2 30	2 20	2 40	3 50	2 75	1 35
Strawberries	..	..	..	..	2 92	2 47
Currants	..	..	2 50	..	2 57	2 00
Potatoes	28 50	22 00	25 00	66 74	21 00	27 83
Other root crops and other crops	11 70	70 00	21 50	39 65	21 00	27 83
Market-garden crops	20 25	30 00	31 00	33 00	21 66	..

Live-stock.

Beef cattle, each	\$ 75 00
Dairy " "	90 00
Horses " "	130 00
Sheep " "	8 00
Swine " "	13 00

FRUIT.

It will be noted that in the following figures allowance should be made regarding areas, inasmuch as the yield returns are approximately correct, while the areas are based upon partial returns from the Crop Correspondents.

No. 1—ISLANDS GROUP.

	Acres.	Estimated Bear- ing Acreage.	Estimated Yield.
Apples	1,388¼	463	26,675 boxes.
Pears	144¼	48	2,000 "
Cherries	145½	48	{ 700 " (sour). 700 " (sweet).
Apricots	1¼	1¼	...
Plums and prunes	163¼	54	2,887 "
Peaches	3¼	...	...
Raspberries	71½	24	12,574 crates.
Strawberries	544¾	181	83,595 "

Apples were generally reported as being a light to very poor crop. Pears, average crop; plums and prunes, poor to fair; cherries, poor to fair; small fruits, good. The short fruit-crop was due to the late spring frosts. A large proportion of the orchards are young, and practically only sufficient fruit is grown for home consumption in many localities.

GROUP No. 2—LOWER MAINLAND.

	Acres.	Estimated Bear- ing Acreage.	Estimated Yield.
Apples	1,387¾	462	9,000 boxes.
Pears	36½	12	100 "
Cherries	19¼	6	{ 200 " (sour). 400 " (sweet).
Apricots	...	...	...
Plums and prunes	273½	91	1,500 "
Peaches	5	2	...
Raspberries	6¾	2	1,058 crates.
Strawberries	11¼	4	2,092 "

The apple-crop was poor, late frosts being accountable for much damage. Pears were a poor crop; plums and prunes, fair to poor; cherries, fair; and small fruits, good.

GROUP No. 3—THOMPSON RIVER WATERSHED.

	Acres.	Estimated Bear- ing Acreage.	Estimated Yield.
Apples	1,481½	185	4,680 boxes.
Pears	98	12	250 "
Cherries	56½	7	{ 1,250 " (sour). 1,650 " (sweet).

GROUP No. 3—*Concluded.*

	Acres.	Estimated Bear- ing Acreage.	Estimated Yield.
Plums and prunes	117 $\frac{3}{4}$	14	...
Peaches	68	8	32 boxes.
Raspberries	8 $\frac{3}{4}$	1	500 crates.
Strawberries	9	1	1,046 „
Currants	4	1	150 „

In the Kamloops District apples were a light crop, the plum, prune, and cherry crops being very poor. Small fruits were a good average.

In the Ashcroft District down to Hope, hardy winter apples paid well; pears were fairly good; plums, prunes, and cherries were very good; and small fruits were a heavy crop.

In Nicola District fruit is scarcely grown in marketable quantities yet.

GROUP No. 4—NORTHERN BRITISH COLUMBIA.

	Acres.	Estimated Yield.
Apples	38	100 boxes.
Pears	2	...
Cherries	2	...
Plums and prunes	2 $\frac{1}{2}$	...
Raspberries	2 $\frac{1}{4}$	395 crates.
Strawberries	6 $\frac{3}{4}$	1,306 „

At Alexandria, in the Cariboo District, fruit-growing is still in the experimental stage. A few apple-trees bore light crops, but late spring frosts damaged the buds. Raspberries were a fair crop.

At North Bonaparte (Clinton) no large fruits were raised this year, but small fruits did well.

At Terrace, in the Skeena District, young apple-trees yielded well; sweet cherries were exceptionally good. Small fruits also bore heavily here and at Masset (Graham Island).

GROUP No. 5—DRY BELT AND BOUNDARY.

	Acres.	Estimated Bear- ing Acreage.	Estimated Yield.
Apples	18,237	3,039	198,825 boxes.
Pears	904 $\frac{3}{4}$	151	5,174 „
Cherries	755 $\frac{1}{4}$	126	{ 3,374 „ (sour). 2,000 „ (sweet).
Apricots	90 $\frac{1}{4}$	15	542 „
Plums and prunes	980 $\frac{1}{4}$	163	22,292 „
Peaches	2,361 $\frac{3}{4}$	393	555 „
Raspberries	166 $\frac{1}{4}$	27	23,571 crates.
Strawberries	168 $\frac{3}{4}$	28	30,021 „
Currants	2	...	430 „

In the Fairview District, including the South Okanagan Valley and Similkameen, the apple-orchards are young and only giving partial crops; plums, prunes, and cherries had light crops; small fruits fair.

At Grand Forks the apple-crop was good, practically a full one. Cherries, pears, plums, and prunes and small fruits bore well.

In the Greenwood District (Rock Creek, etc.) there are many young trees not producing yet. Small fruits did well where grown.

In the northern part of the Okanagan Valley the apple-crop was light; plums and prunes, fair; cherries, poor; and small fruits, good. At lake points farther south, apples were medium and other fruits fair. Peaches were a failure, owing to spring frosts.

GROUP NO. 6—EAST AND WEST KOOTENAYS.

	Acres.	Estimated Bearing Acreage.	Estimated Yield.
Apples	1,499½	375	18,000 boxes.
Pears	127¾	32	35 „
Cherries	133½	33	{ 158 „ (sour). 126 „ (sweet).
Apricots	43	11	...
Plums and prunes	40¾	10	510 „
Peaches	53½	13	225 „
Raspberries	28¼	7	3,982 crates.
Strawberries	90	22	16,092 „
Currants	30½	8	1,418 „

East Kootenay Section.

Small fruits were a very good crop at Athalmer and Wilmer. At Cranbrook the crop of large fruits was light, whilst at Moyie and Wasa trees are scarcely of bearing age yet. Strawberries and currants were a good crop.

West Kootenay Section.

Revelstoke District.—Apples, plums, and prunes are all young here, as is the case at Nakusp and Arrowhead, and the crop was light.

Kaslo District.—At Lardo and Mirror Lake small fruits were good, apples medium, and other fruits light. At Crawford Bay and Ainsworth the apple-crop was medium; small fruits, fair.

Rossland District.—Most of the orchards are young and bearing light crops. Sour cherries were a heavy crop at Elko; small fruits generally a medium to heavy crop.

The total acreage in orchard accounted for by Crop Correspondents is 31,819 acres, and allowing 10 per cent. for omissions, etc., a fair estimate of total plantings up to 1911 would be 35,000 acres.

The crop of apples this year is about 40 per cent. of that of 1910; all other fruits also yielding light crops. The total estimated value of fruits and berries was \$878,181.

TREE-PLANTING, ETC., IN 1911.

The acreage newly planted to fruit in 1911 is estimated at 10,500 acres; and of the standard fruit-trees, seedlings, grafts, and bush fruits required, 151,751 dollars' worth were imported from various points; the balance, valued at \$199,038, being raised in the home nurseries throughout the Province.

At interior points winter apples of the following varieties have been planted almost exclusively: McIntosh Red, Jonathan, Wagener, Grimes Golden, Rome Beauty, Winesap, Spitzenberg, and Yellow Newtown, the varieties varying according to locality.

Few peaches, but an increased number of apricots, were planted in the more southerly districts.

The acreage in strawberries and raspberries has been largely increased in the West Kootenay districts, and to a lesser extent on the Lower Mainland.

Vegetables of all varieties throughout the Province have been an excellent crop (see tables of separate districts for produce), the total value of the fruit and vegetable crop for the year being estimated at \$5,084,241, against \$1,939,110 for 1910.

MOVEMENT OF FRUIT AND VEGETABLES

By Rail During Season 1911.

(Supplied by the C.P.R. Co. and Dominion Express Co.)

VEGETABLES.

Vegetables (mixed)	2,045½ tons
Potatoes	692 "
Onions	838 "
Roots	9,804 "
Tomatoes	226 "

13,605½* tons

* It will be understood that the above figures only represent a percentage of the whole crop, a large proportion being consumed locally, and a considerable quantity being shipped by water, no record being kept of same.

FRUIT.

Apples	3,076	tons
Pears	37½	"
Peaches	29½	"
Plums	9½	"
Prunes	47	"
Mixed fruit	435	"
	<hr/>	
	3,634½*	tons
	<hr/>	
Fruit and vegetables (unclassified)	1,392	tons
Canned goods	270	"
	<hr/>	
	18,902	tons
	<hr/>	

The totals for 1910 were 8,745 tons, the increase in 1911 being 116.1 per cent.

* It will be understood that the above figures only represent a percentage of the whole crop, a large proportion being consumed locally, and a considerable quantity being shipped by water, no record being kept of same.

PRICES OF PACKED FRUIT.

FOR YEARS 1909, 1910, AND 1911.

	Average, 1909 and 1910	Average, 1911.	
		Highest.	Lowest.
Apples, 40-lb. box	\$1.30	\$1.75	\$1.25
Crab-apples, 40-lb. box	1.40	2.00	1.50
Pears, 40-lb. box	1.45	2.00	1.25
Plums, 20-lb. box	80	1.00	60
Prunes, 20-lb. box	70	1.00	60
Peaches, 20-lb. box	70	1.58	1.07
Cherries (sour), per lb.	09¼	2.25 box	2.00 box
Cherries (sweet), per lb.	..	1.25 "	1.00 "
Strawberries, 24-lb. crate	2.45	2.75	1.75
Raspberries, 14-lb. crate	1.70	2.75	2.25
Blackberries, 14-lb. crate	1.65	..	..
Gooseberries, per lb.	07¾	..	..
Currants, per lb.	06	2.50 crate	2.25 crt.
Loganberries,	..	2.50 "	..

I.—IMPORTED NURSERY STOCK.

INSPECTED AND CONDEMNED AT THE PROVINCIAL FUMIGATING-STATION,
VANCOUVER, B.C., IN 1911.

	Number inspected.	Number condemned.	Per Cent. condemned.
Standard fruit-trees (total)	369,874	17,816	4.8
Standard apples and crabs	255,099	13,278	5.2
Nut and fig trees	2,499	2	..
Seedlings and grafts	2,704,629	93,020	3.4
Bush fruits (grapes, currants, raspberries)	94,069	543	0.5
Small fruits (strawberries, etc.)	60,656	..	..
Miscellaneous stock	398,307	2,322	0.5

II.—NET IMPORTS OF NURSERY STOCK, WITH VALUES, FOR 1911.

CANADIAN PROVINCES AND DUTIABLE.

	Estimated Value.
Standard fruit-trees, 352,058, valued at \$15 per 100..	\$ 52,808
Nut and fig trees, 2,497, valued at \$20 per 100	499
Seedlings and grafts, 2,611,609, valued at 2 cents each	52,232
Bush fruit-trees, 93,526, valued at 25 cents each ...	23,381
Small fruits, 60,656, valued at \$5 per 100	3,032
Miscellaneous stock, 395,985, valued at \$5 per 100 ...	19,799

Total \$151,751

Value of nursery stock imported from United States,
etc. \$19,506

From Canadian Provinces \$132,245

Estimated value of nursery stock produced in British
Columbia \$199,038

III.—IMPORTED FRUIT, ETC.

INSPECTED AND CONDEMNED AT VANCOUVER, B.C., IN 1911.

	Number inspected.	Number condemned.	Per Cent. condemned.
Apples .....boxes	165,405	4,553	2.7
Pears "	25,003	2,510	10.0
Plums "	19,714	455	2.3
Peaches "	85,389	768	0.8
Apricots "	10,757	..	..
Nectarines "	39	..	..
Prunes "	9,267	25	0.2
Quinces "	149	..	..
Oranges, Californian "	94,725	3,407	3.5
Oranges, Japanese "	92,609	2,118	2.2
Oranges, Australian "	110	..	..
Oranges, Tangerine "	20	..	..
Lemons "	16,704	104	0.6
Grape Fruit "	3,650	409	11.2
Limes "	64	..	..
Pine-apples "	727	..	..
Persimmons "	10	..	..
Passion Fruit "	40	..	..
Tomatoes "	23,243	55	0.2
Peppers "	247	..	..
Total "	547,872	14,404	2.6

IV.—RETURN OF IMPORTED FRUITS, ETC.

INSPECTED AT VANCOUVER, B.C., IN 1911.

	Boxes (Net).	Average Net Weight. Lb.	Total Weight. Lb.
Apples	160,852	40	6,434,080
Pears	22,493	40	899,720
Plums	19,259	20	385,180
Peaches	84,621	20	1,692,420
Apricots	10,757	20	215,140
Nectarines	39	20	780
Prunes	9,242	20	184,840
Quinces	149	{ 35-40, large } 20, small }	4,605
Oranges, Californian	91,318	72	6,574,896
Oranges, Japanese	90,491	{ 10-12, small } 15-17, large }	1,221,628
Oranges, Australian	110	35-40	4,125
Oranges, Tangerine	20	15-20	350
Lemons	16,600	78	1,294,800
Grape Fruit	3,241	68	220,388
Limes	64	75-85	5,120
Tomatoes	23,188	20	463,760
Pine-apples	727	80-100	65,430
Peppers	247	5-10	1,852
Persimmons	10	20	200
Passion Fruit	40	50	2,000
Total	533,468	..	19,671,314

APIARIAN STATISTICS FOR SEASON 1911.

WEST OF LILLOOET DIVISION.

Estimate of Efficiency. Per Cent.	Possibilities of Locality. Lb.	Total Number of Bee-keepers.	District.	Number of Colonies, 1st April.	Honey-production. Lb.	Average Production per Colony. April. Lb.	Number of Colonies, 1st October.
15	2,000	15	Agassiz	57	318	5.5	72
40	15,420	46	Chilliwack ...	257	6,530	25.4	357
20	5,000	25	Comox	85	1,193	14.0	121
50	3,000	4	Dewdney	51	1,531	30.0	77
33	5,000	1	Harrison Mills	3	24	8.0	5
13	(not good)	11	Hatzic	119	1,778	15.0	135
75	400	15	The Islands ..	38	84	2.2	50
5	2,400	2	Lillooet	7	60	8.5	10
50	1,000	10	Lytton	24	1,700	70.0	30
20	36	1	Ladysmith ...	33	56	1.7	46
50	2,500	10	Mission	35	900	25.9	46
20	1,800	10	Nanaimo	49	1,244	25.3	85
50	1,000	9	Rosedale	36	245	12.0	40
20	1,000	9	Sardis	21	245	12.0	40
50	1,000	2	Steveston	60	1,800	30.0	60
Totals	..	163	..	875	17,463	19.9	1,134

Total honey-production, 17,463 lb.; possibilities of district, 39,520 lb.; estimated efficiency of bee-keepers, 30 per cent.

KOOTENAYS, DRY BELT, AND BOUNDARY DIVISION.

Remarks.	Total No. of Bee-keepers.	District.	Number of Colonies, 1st April.	Honey- production.	Average Production per Colony, April.	Number of Colo- nies, 1st October.
				Lb.	Lb.	
Died.	1	Athalmer	..	..	..	..
..	1	Brisco	..	..	..	..
No bees kept.	..	Golden	..	..	..	..
..	4	Grand Forks	34	2,125	62.5	54
No bees kept.	..	Kamloops	..	..	..	..
..	4	Kelowna	..	..	..	29
..	3	Keremeos	..	..	..	7
..	1	Malakwa	1	25	25.0	..
..	2	Rossland	30	750	25.0	80
..	18	Salmon Arm	77	620	8.0	171
Winter-killed	1	Seymour Arm ..	..	..	..	..
..	1	Trail	..	..	..	3
..	2	Vernon	50	1,800	36.0	42
..	2	Walbachin	1	..	..	3
..	2	Wilmer	..	..	..	3
No bees kept.	..	Windermere	..	..	..	..
Totals..	42	..	193	5,320	27.5	392

Total honey-production, 5,320 lb.

Estimated total number of bee-keepers in British

Columbia 1,105

Colonies, April, 1911 7,306

Total honey-production 100,495 lb.

Honey imported in 1911, duty paid 123,666 lb.

Honey imported in 1911 (estimated from Cana-
dian Provinces) 301,485 ..

Total 425,151 ..

Average Prices.

British Columbia production 35 cents per lb.

United States, etc., production 14 " " "

Eastern Provinces 25 " " "

COMPARISON OF TOTAL AGRICULTURAL IMPORTS AND HOME PRODUCTION.

	Year 1910 (Totals).	Year 1911 (Totals).	Increase.	Decrease.
Live-stock and poultry ...	\$ 7,826,151	\$ 7,760,778	...	\$65,373
Dairy produce	6,347,351	6,263,743	...	83,608
Meats	1,649,600	2,003,108	\$ 353,508	...
Fruit and vegetables	2,270,571	5,631,525	3,072,565	...
Eggs and honey	424,326	1,355,850	889,510	...
Malt, hay, grain	10,729,074	12,148,150	1,212,316	...
Miscellaneous	339,142	1,178,628	937,980	...
	\$29,586,215	\$36,341,782	...	...

Increase for the year 1911, \$6,755,567, or 22.8 per cent.

The total value of home-produced and imported articles for consumption for the year 1911 is \$36,341,782, against \$29,586,215 for the year 1910. This is an increase of \$6,755,567, or 22.8 per cent. for the whole year.

Taking the values of imported products in 1911, we find the total to be \$14,699,854, a decrease of \$487,371, or 3.2 per cent., compared with the 1910 figures (\$15,187,225). This year, also for the first time in the history of British Columbia, the value of live-stock, dairy and other agricultural products produced in the Province exceeded the combined values of similar imports from all other points, the figures being as follows: Home products, \$21,641,928; total imports, \$14,699,854; excess, \$6,942,074, or 47.2 per cent.; and the value of similar home products in 1910 is exceeded by \$7,242,838, or 50.3 per cent.

The chief increases in home production are as follows:—

	1910.	1911.	Increase, Per Cent.
Milk	\$2,563,837	\$3,295,000	28.6
Fruit and vegetables	1,939,110	5,084,241	162.1
Eggs	156,247	255,112	63.2
Honey	3,200	35,173	...
Hay	3,947,530	4,913,566	24.4
Grain	1,400,000	2,160,327	54.3

DUTIABLE IMPORTS.

As regards dutiable imports, the figures for 1911 (\$3,840,183) show an increase of \$1,486,551, or 63.1 per cent., over those of 1910, the chief increases being in the following items:—

	1910.	1911.	Increase, Per Cent.
Live-stock	\$254,221	\$523,301	105.8
Canned meats, pickles, jams, etc.	266,063	505,359	89.9
Eggs	114,233	471,616	312.8
Butter	173,879	344,735	98.2
Hay	105,777	237,674	124.6
Fruits (green)	331,461	543,114	63.8

Decreases.

	1910.	1911.	Decrease, Per Cent.
Malt	\$49,167	\$10,233	79.1
Condensed milk	10,367	7,367	28.9

The increase in above articles of consumption is very noticeable, showing the rapid growth of population.

As regards the figures for malt, it is understood that Eastern malt is, to a certain extent, supplanting the United States product, Winnipeg being the chief shipping-point now, but no reliable figures are available at present as to what extent the supply coming from the East originated in the United States.

IMPORTS FROM PROVINCES IN THE DOMINION.

These were valued at \$12,833,593 in 1910, and \$10,859,671 in 1911, showing a decrease of \$1,973,922, or 15.3 per cent., the chief decreases being in the following items:—

	1910.	1911.	Decrease. Per Cent.
Live-stock and poultry	\$5,000,065	\$3,471,105	30.5
Butter, cheese, and milk	2,477,493	1,589,021	35.8
Grain	2,226,600	2,021,464	9.2

Increases.

	1910.	1911.	Increase. Per Cent.
Eggs	\$129,435	\$501,517	280.7

A striking feature of the statistics for 1911 is the large increase of 63.1 per cent. apparent in the importation of dutiable agricultural products, chiefly from the United States, whilst similar imports from Canadian Provinces show a decrease of 15.3 per cent. on the total value.

Although the total agricultural imports from the Dominion amounted to \$10,859,671, and from the United States (chiefly) to only \$3,840,183, yet the fact is disturbing that foreign imports are increasing so largely at the expense of Dominion interests; this probably being due to the lack of co-operative enterprise at home. This Province is expanding so rapidly that the home supply of all agricultural products, although showing a great increase during the past year, is quite inadequate to meet the demand. American producers have apparently grasped this fact more quickly than their Eastern Canadian competitors, and, having in their favour increased transportation facilities, their surplus products have been shipped in at the lowest possible figure to allow of a marginal profit to all parties.

MARKETS, LIVE-STOCK, ETC.

The total importations of dairy and poultry products into British Columbia for the year 1911 were as follows:—

Butter	\$954,908
Milk (including condensed) and cream	373,667
Eggs	973,133
Poultry	1,142,735
Cheese	654,706

Total \$4,099,149

Excluding cheese, of which practically none is made in British Columbia, there is a total of \$3,500,000 sent out of the Province annually for articles which should be produced at home.

The year's importations of fresh meats, including bacon and ham, mutton and lamb, pork and lard, total \$1,260,091, whilst beef cattle, sheep and swine were imported to the value of \$1,260,510.

In the past year there has been a noticeable increase in the consuming-capacity of Prairie markets, due mainly to increased population, and also to the fact that a late and wet season there furnished an unusually favourable market for early vegetables.

There has also been an increased demand for British Columbia apples from Australian houses, and for all fruits and vegetables from Coast markets. The home markets, however, fall far short of being supplied, and in the year 1911 the Province imported the following fruits and fruit products, etc., chiefly from the United States:—

Apples, other fruits and berries	\$547,284
Preserved fruits	255,367
Jellies, jams, etc.	111,856
Pickles	59,443
Total	<hr/> \$973,950

Similar products totalled \$542,107 in the year 1910.

The greatest increase in consumption of food products during the past year has been in bacon and ham, mutton and lamb, pork, eggs, and poultry. The value of dairy produce (exclusive of milk) importations amounted to \$1,609,614, and the value of dressed poultry and egg importations amounted to \$2,115,868.

The home production of dairy produce (exclusive of milk) amounted in value to \$985,462, or 61 per cent. of the market demand. The demand also for dressed poultry and eggs was \$1,234,472 in excess of the home supply. A satisfactory feature of the year has been an increase in the supply of home-produced milk, valued at \$3,295,000, and eggs, valued at \$255,112. Eggs, however, show a still greater increase in importations from the United States and Canadian Provinces, the increase from the former being 312.8 per cent., and from the latter 280.7 per cent. on the values for 1910.

The rapid growth of city population has resulted in an increased demand for milk, which has affected the quantity of butter manufactured.

The increased demand for mutton and pork has not been met with a corresponding development in the raising of sheep and swine, the numbers of the former showing a lessened production during the year.

As in the past year, the heaviest importations in live-stock have been in horses, beef cattle, and sheep, the United States imports of horses showing the very large increase of 300 per cent.

DUTIABLE AGRICULTURAL PRODUCTS.

IMPORTED FROM FOREIGN COUNTRIES FOR THE YEARS 1910-1911.

	1910.		1911.	
	Quantity.	Value.	Quantity.	Value.
Horses .....No.	929	\$ 98,993	2,968	\$ 294,116
Cattle "	55	4,075	368	10,341
Sheep "	39,013	151,153	61,471	218,644
Swine "	..	..	14	200
Poultry, estimate, year 1911, lb.	..	..	512,437	117,860
Bacon and hams "	2,383,716	432,901	3,261,328	487,443
Canned meats "	333,535	55,417	552,337	78,693
Mutton and lamb "	2,681,729	203,382	3,317,915	246,068
Pork "	145,704	20,337	165,106	21,713
Lard "	2,192,429	317,509	2,199,322	244,976
Eggs .....doz.	535,704	114,233	2,362,039	471,616
Butter lb.	697,063	173,879	1,485,825	344,735
Cheese "	209,313	40,207	233,836	42,158
Hay tons	5,827	105,777	15,283	237,674
Malt lb.	2,195,778	49,167	655,473	10,233
Condensed milk "	161,902	10,367	65,213	7,367
Pickles .....gals.	43,393	41,876	64,867	59,443
Fruits, viz. :—				
Apples .....bbl.	39,101	138,445	67,481	245,322
Berries lb.	347,316	38,665	530,031	59,612
Cherries "	141,186	15,072	205,401	24,922
Cranberries .....bus.	3,961	8,478	2,801	9,710
Currants lb.	108	8	1,935	308
Grapes "	701,037	38,194	1,191,831	57,647
Peaches "	1,269,686	34,389	1,859,072	60,776
Plums .....bus.	7,141	17,679	11,625	33,519
Quinces, apricots, pears, etc. lb.	1,015,225	40,276	1,381,760	51,252
Fruit, other, green "	..	255	..	39
Fruits, preserved lb.	2,275,914	95,944	3,219,586	255,367
Jellies, jams, etc. "	1,002,743	72,826	1,364,633	111,856
Nursery stock "	..	12,917	..	19,506
Honey lb.	134,457	21,211	123,666	17,060
Total	..	\$2,353,632	..	\$3,840,183

AGRICULTURAL

	HOME PRODUCTION.		
	1911.		1910.
	Quantity.	Value.	Quantity.
Horses No.	8,959	\$ 1,343,850	2,828
Cattle, beef "	13,442	1,008,150	28,395
" dairy "	4,171	375,390	43,313
Sheep "	13,458	107,664	13,390
Swine "	14,398	187,174	1,868,750
Poultry lb.	2,505,136	626,284	..
Live-stock	..	3,648,512	..
Butter lb.	2,463,655	985,462	3,090,195
Cheese "	..	..	..
Milk gal.	10,985,000	3,295,000	9,375,300
Dairy produce	..	4,280,462	..
Bacon, ham lb.	2,220,000	399,536	2,000,000
Mutton, lamb "	1,475,060	111,860	1,340,964
Pork "	1,602,744	223,707	1,457,040
Lard "	49,462	7,914	44,966
Meats	..	743,017	..
Apples lb.	10,291,200	385,920	..
Other fruits "	1,084,380	62,328	48,477,630
Berries "	3,843,442	429,933	..
Vegetables tons	162,966	4,206,060	..
Fruits and vegetables	..	5,084,241	..
Eggs doz.	850,373	255,112	446,420
Honey lb.	100,495	35,173	20,000
..	..	290,285	..
Malt lb.	..	..	..
Hay tons	223,597	4,913,566	207,770
Grain—wheat, oats, barley, and rye bus.	2,460,926	2,160,327	1,575,600
Flax "	40	80	..
Hops lb.	518,500	207,400	..
Nursery stock	..	199,038	..
Miscellaneous—canned meats and jams, etc. . . . lb.	3,300,000	115,000	..
..	..	7,595,411	..
Totals	..	\$21,641,928	..

* This was valued too high; 66 cents per gal. would be an average, or \$547,359 total.

† Fruit-import figures shown as \$163,620 in Budget figures for 1911.

‡ Imports from all points in 1910 totalled \$15,187,225, and not \$14,962,904 as shown in B.

AL PRODUCTS (PROVINCIAL AND IMPORTED)

FOR THE YEARS 1910 AND 1911.

		IMPORTED FROM CANADIAN PROVINCES.				IMPO
1910.		1911.		1910.		19
	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.
28	\$ 606,000	5,985	\$ 1,947,375	2,596	\$ 608,007	2,968
95	1,135,820	{ 11,497	689,820	56,736	2,267,565	.. 368
13	303,193	1,203	138,345	(No ret urns.)	859,493	61,471
90	191,477	153,677	537,870	105,365	151,600	14
50	335,375	2,188	32,820	15,160	1,113,400	512,437
		5,124,378	1,024,875	5,567,000		
	2,571,865	..	3,471,105	..	5,000,065	..
95	1,081,568	3,050,865	610,173	4,680,041	1,171,860	1,485,825
00	2,563,837	3,039,694	612,548	3,200,000	640,000	233,836
		732,600	366,300	829,333	665,633*	(lb.) 65,213
	3,645,405	..	1,589,021	..	2,477,493	..
000	363,215	1,087,109	217,422	(No ret urns.)	..	3,261,328
64	101,691	..	..	..	..	3,317,915
40	203,370	..	..	..	..	165,106
066	7,195	212,349	42,469	(No ret urns.)	..	2,199,322
	675,471	..	259,891	..	..	..
		{ 78,900	3,900	(No ret urns.)	..	8,097,720
30	1,939,110	..	.. 270	..	..	5,277,439
		2,700	..	..	..	700,026
	1,939,110	..	4,170	..	..	..
20	156,247	2,507,588	501,517	803,556	129,435	2,362,039
000	3,200	301,485	75,372	(No ret urns.)	..	125,666
	159,447	..	576,889	..	129,435	..
		..	..	..	..	655,473
70	3,947,530	155,827	2,804,886	150,001	3,000,000	15,283
00	1,400,000	1,837,695	2,021,464	2,250,400	2,226,600	..
	..	..	..	..	..	..
	..	..	..	..	..	..
	..	..	132,245	..	..	..
	60,162	..	..	..	..	..
	5,407,692	..	4,958,595	..	5,226,600	..
	\$14,398,990	..	\$10,859,671	..	\$12,833,593‡	..

in Budget Speech for 1911.

EXPORT FRUIT-PACKAGES, ETC., IN BRITISH COLUMBIA.

INSIDE MEASUREMENTS.

	Size of Box, etc. Inches.	Average Weight (Net).	Remarks.
Apples	10 x 11 x 20	41 lb.	
Crab-apples	10 x 11 x 20		
	(apple)	50 "	The half apple-box is also used on the Lower Mainland.
	18¼ x 11 x 8½		
	(pear)	40 "	As used in Upper Country; half pear-box and peach-box (20 lb.) also sometimes used.
Pears	18¼ x 11 x 8½	46-48 "	
Peaches	18¼ x 11¾ x 4	17-21 "	
	18¼ x 11¾ x 4¼	..	
	18¼ x 11¾ x 4½	..	
Plums	15¾ x 15¾ x 4¼	20-22 "	4-basket crate.
Prunes .....	.. ..	20-25 "	Shipped largely in peach-boxes.
Apricots	15¾ x 15¾ x 4¼	19-20 "	4-basket crate.
Cherries	18½ x 9 x 2¼	8½-9 "	Sour cherries (4-basket crate), equals 16-18 lb. Sour cherries (special pack), equals 24 lb.
Raspberries	2/5-quart carton (24 to 1 crate); size of carton, 5¼ x 5¼ x 1	14 "	Size of crate, 16¾ x 23¼ x 5¼.
Strawberries	4/5-quart carton (24 to 1 crate); size of carton 5⅞ x 5¼ x 8	24 "	Size of crate, 16¾ x 23¼ x 6¾.
Loganberries	2/5-quart carton (24 to 1 crate)	16 "	
Currants .....	.. ..	..	As for strawberries.
Grapes	6-quart basket (approximately)	..	Six 6-quart baskets reckoned as 100 lb. by the Express Co.
Rhubarb	20 x 15¾ x 7¾	40 "	
Cantaloupes	12 x 11½ x 20¼	..	
Tomatoes	18¼ x 11¾ x 5	23 "	
Cabbage	25 x 23 x 18	..	
Lettuce	28¼ x 16 x 12	..	

INDEX.

	PAGE.
Introduction	3
Mixed farming	5
Average production of grain, hay, roots, etc.	17
Summary of crops and stock, with values	19
Average prices	21
Fruit	22
Tree-planting	24
Movement of fruit and vegetables (C.P.R. Co., and Dominion Express Co.)	25
Prices of packed fruit	27
Nursery stock imported, etc.	27
Imported fruit inspected and condemned	28
Apiarian statistics	29
Imports and home production of Agricultural products	30
Markets and live-stock	32
Dutiable agricultural imports, 1910 and 1911	34
Table of agricultural products, 1910 and 1911	35
Table of export fruit-packages	37

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1912.

PROVINCE OF BRITISH COLUMBIA.

DEPARTMENT OF AGRICULTURE
(WOMEN'S INSTITUTES).

BULLETIN No. 46.

FOOD AND DIET: PART I.

—BY—

MISS ALICE RAVENHILL,
Fellow of the Royal Sanitary Institute, etc., etc.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1912.

PROVINCE OF BRITISH COLUMBIA.

DEPARTMENT OF AGRICULTURE
(WOMEN'S INSTITUTES).

BULLETIN No. 46.

FOOD AND DIET: PART I.

—BY—

MISS ALICE RAVENHILL,
Fellow of the Royal Sanitary Institute, etc., etc.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

**PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.**

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1912.

FOOD AND DIET PART I.

DEPARTMENT OF AGRICULTURE,

VICTORIA, B.C., October, 1912.

The Honourable Price Ellison,
Minister of Agriculture.

SIR,—I have the honour to submit herewith Bulletin No. 46, entitled "Food and Diet, Part I.," prepared on behalf of the members of the Women's Institutes.

I have the honour to be,

Sir,

Your obedient servant,

WM. E. SCOTT,

Deputy Minister of Agriculture,

Superintendent of Institutes.

FOOD AND DIET:

PART I.

THERE was a certain little Dutch boy, named Jacob Moleschott, born in the Netherlands so long ago as August 9th, 1822, to whom the study of the human body and its functions were of such absorbing interest that he became, in course of time, a foremost authority on the processes by which the food we eat becomes built up into our very substance, changing in marvellous fashion into blood, bones, muscles, and nerves. Indeed, young Moleschott devoted his brilliant abilities to this subject of human nutrition to such purpose that he held the position of Professor of Physiology (i.e., the knowledge of how each part of the body performs its special work) at no less than three prominent European universities, and was made a Senator of the Kingdom of Italy while still in the prime of life.

His opinion on matters connected with food and diet is consequently entitled to respect, and the quotation of one of his favourite sayings will form a good introduction to this bulletin:—

**“COURAGE, CHEERFULNESS, AND A DESIRE TO WORK DEPEND
MOSTLY ON GOOD NUTRITION.”**

That is to say, that when in good health we possess *courage* to face uncomplainingly the little frets and fatigues of daily life, as well as the power to brace ourselves to solve its big problems or to bear the shock of bereavement, suffering, or loss.

Cheerfulness does not desert us when engaged in the monotonous round of daily tasks, any more than when surrounded by a party of merry friends. Infused with the buoyant energy of health, the *desire for work* is so keen that it is carried on as conscientiously in the privacy of family life as when stimulated by the competition of the commercial world or by the applause of public opinion. On the contrary, when weak or poorly—that is, when nutrition is defective—this energy for work gives place to weary boredom and languor.

Seeing, therefore, this

CLOSE CONNECTION BETWEEN FOOD AND EFFICIENCY,

it is obviously our duty to learn at least the broad principles upon which healthful diet depends. There is, of course, a still prevalent opinion that what we eat or drink is purely our own concern, a question merely of taste, convenience, custom, or purse. Whereas modern teaching confirms the opinion of Jacob Moleschott, that to a large extent harmonious living depends on daily diet.

WHAT IS NUTRITION,

that it should bulk thus prominently in the comfort, the happiness, and the productiveness of life? To be in a state of good nutrition may be defined as that condition of the body when all its requirements for growth, repair, and capacity for work are satisfactorily fulfilled. Professor Chittenden (of Yale University, U.S.A.), who is devoting his life to the promotion of intelligent human nutrition, through his study and teaching on this vital subject of food and diet, has aptly described these requirements and their accomplishment by means of food as

THE THREE GREAT MYSTERIES OF LIFE.

How rarely most of us give even a passing thought to either one of these "great mysteries":—

- (1.) The power of the child to grow:
- (2.) The power of the body to repair its worn-out parts:
- (3.) The power it possesses to perform work; not only what is commonly called work—namely, muscular activity carried on under the conscious direction of the brain—but also those marvellous, ceaseless activities of the internal organs—heart, lungs, liver, intestines, for example—performed independently of our will, which are practically continuous throughout life.

THE GROWTH OF THE BRAWNY, MUSCULAR MAN,

from the microscopic atom which was his beginning, depends materially upon the food with which he is supplied during the twenty-five years of active, bodily growth.

Measurements show conclusively that growth in height and weight are influenced to a remarkable degree by

THE DIET OF THE CHILD.

Thus the results of a most carefully conducted investigation carried out in Scotland showed that, in families where the income was approximately equal, the children of careless, ignorant parents, who took no trouble about the character of their food, averaged at thirteen years of age 11 lb. less in weight and $3\frac{1}{4}$ inches less in height than children in homes where thought and trouble were given to this important matter. But of far greater moment than the quantity of bodily increase is its *quality*.

Mental capacity, a well-balanced nervous system, a high standard of morality, are the product, to a degree realized by but few of us, of the standard of nutrition maintained during the years of growth.

THE WEAKNESS AND LOSS OF FLESH ASSOCIATED WITH DEFICIENT FOOD,

and the fact that death succeeds prolonged starvation, are results so familiar that no further proofs are called for to show that, in the absence of suited food, the daily wear and tear of the body are not made good; it wastes away, while the power to move and work gradually ceases.

Now, most of us have at some time or another heard

THE HUMAN BODY COMPARED TO A STEAM-ENGINE;

though, as a matter of fact, it is infinitely more marvellous in its construction and mode of work than any man-made machine. Still, the comparison helps us to explain this subject of what food does for our bodies; for some kinds of food may be described as the *building material* of which the engine is constructed, while other kinds of food (called "*energy-producers*") correspond to the fuel employed to heat the engine's boilers. If the metal of which the engine is constructed is poor in quality, or if repairs be carelessly carried out, the engine falls to do good work, no matter how abundant and excellent is the fuel with which its fires are stoked. Or if the fuel be poor in quality or deficient in quantity the most perfectly built engine becomes useless. Similarly with the body. If poor material is supplied in the form of food, either growth, power of self-repair, or capacity for work, or possibly all three, will suffer to a greater or less degree.

A large proportion of discomfort, languor, irritability, disappointments in life, as well as actual sickness, are the results, not of *deficient food*—that would be easily understood—but of

DEFECTIVE FOOD;

a much more common fault in a country where the standard of living is fairly high. Money may be freely spent upon the most costly forms of food and endless trouble may be lavished on its preparation, but the results are fruitless, or even actively detrimental to health, if the food is not suited to the eater.

It is no exaggeration to say that

THE SUFFERING ASSOCIATED WITH ERRORS IN DIET IS INCALCULABLE.

Bodily vigour is diminished, mental alertness is dulled, there is failure to resist disease, and a general deterioration is brought about. The conclusion of the whole matter may be briefly summarized as follows:—

Food is the most important source from which material is supplied for the growth of the body, for its repair, and for furnishing it with material from which to produce heat or energy for its activities.

The study of nutrition is concerned—

- (1.) With the various ways in which the different kinds of food and drink serve the needs of the body throughout life;
- (2.) The value of these different kinds of food and drink under different circumstances or for different purposes.

DOUGHT WE THEN TO GIVE CONSTANT CONSIDERATION TO WHAT WE EAT AND DRINK?

The reply to this most natural inquiry will take the form of another question, namely: Who is included in this pronoun “we”? If it includes each member of every household, the answer will be

AN EMPHATIC “NO.”

It would be morbid and undesirable to concentrate too much attention upon the selection of our daily diet, but if the “we” refers to housewives only, then the answer would be

AN EQUALLY EMPHATIC “YES.”

It is plainly the cook's duty to prepare and present at table food suited to the requirements of the consumers. What these requirements are it is the purpose of this bulletin to show.

THE LESSONS OF EXPERIENCE.

In order to understand why experience has guided healthy human beings to choose and to combine at one meal those foods which are in common use all over the world, it will be of interest to learn what each kind of food does for the body after it has been digested, for then it becomes apparent how reliable a guide Nature is, if we will but follow her lead. Take, for example,

A MIDDAY MEAL

of roast, stewed, or boiled meat, potatoes, cabbage, bread, stewed fruit, with a light pudding or cream. Millions of families sit down to just such a meal daily in the continents of Europe and America.

Why is this combination of food so generally chosen and enjoyed? Well, *lean meat builds up and repairs the bodies* of those who have been spending several hours in various forms of activity, physical or mental.

Fat meat supplies fuel for the furnaces of their bodies, which need to be stoked periodically, as the reservoir of a lamp needs to be refilled with oil.

Potatoes, bread, and a light pudding (if that form part of the menu) *provide fuel* also, but of a somewhat different kind from the fat of meat, or cream. It can be turned to account more quickly as a source of heat or energy in the body. It might be compared to the kindling, useful to start a fire or to revive it, whereas fat resembles more nearly the coal subsequently employed to keep the fire in over many hours. Or, to use another simile, fat taken as a fuel-food resembles the money lying at our account at the bank, to be drawn upon when the money in our purse (which we spend daily, and to which we can compare the fuel supplied by cereals, vegetables, and fruits) needs to be replenished or supplemented.

Finally, the cabbage and stewed fruit eaten at this dinner consist almost entirely of *water*, of which the body requires a very large amount. They also contain what are known as "*salts*," mineral substances which are necessary to the building-up and well-being of the body.

Many people add condiments (i.e., pepper, mustard, vinegar) to their food as they eat it; and some form of beverage is taken with every meal to satisfy the body's need for fluid. This review of the

CONSTITUENTS OF THE FOOD TAKEN AT AN ORDINARY MEAL

shows that they may be separated into five kinds or classes, to which attention must now be given.

It is advisable from the beginning of our study to assign the correct name to each class of food, so that future references to this subject may be easily understood. Indeed, there is no difficulty in remembering either these names or the particular work each does in the body, for, of the five names, three are quite familiar, viz.: *fat*, *salts*, and *water*; and the other two act as reminders of their functions in the body.

By far the most important class of foodstuff is the first, known as *protein*, a word which signifies *to be of the first importance, to be pre-eminent*; because only the foods found in this class contain the building material indispensable to life. Were they banished from the diet, death would inevitably ensue. Meat, fish, game, poultry, eggs, milk, and cheese, all contain this vital "*protein*." It is present also in corn, wheat, oats, peas, beans, and lentils, but in less digestible form than in animal foods.

In the second class—viz., *fats*—are included animal fats, such as suet, dripping, lard, butter, and cream; as well as vegetable fats, olive-oil, for instance, and the oil contained in nuts. These fats are all sources of heat and energy to the body, whence they are distinguished as fuel or warmth-giving foods.

It has already been pointed out that the third class, called *carbohydrates*, consists also of energy-producing or fuel foods. Its very name suggests this office, for it is composed of two Latin words meaning coal and water. That the name accurately describes the composition of the foods found in this class becomes apparent when it is understood that they consist chiefly of water and of solid substances, which serve the body much as coal, oil, or wood serve an engine. These solid substances are forms of starch and sugar, and are present in flour, cornstarch, rice, sago, tapioca, potatoes, oatmeal, and other farinaceous foods and cereals; while sugar is found in all fruits.

A potato, for instance, consists of 81 per cent. of water and rather more than 15 per cent. of starch. Fresh peas contain 78 per cent. of water and 16 per cent. of starch; and though rice or cereals are almost pure starch when purchased in a dried condition, large quantities of water must be used in their preparation before they are fit for food. Most fruits, such as apples, peaches, or berries, contain from 85 to 90 per cent. of water and from 5 to 15 per cent. of sugar.

"STOP A MOMENT,"

some one will exclaim. "You have mentioned oatmeal in two classes of food-stuffs, once as an illustration of those containing body-building material and then as an example of carbohydrate food. Now, which statement is correct?"

Both are right, my friend, for, rich as oatmeal is in protein, it is even richer in carbohydrates, and perhaps it may surprise you further to learn that it contains fat too. It is owing to the fact that cooked oatmeal contains representatives of all five classes of foodstuffs—protein, fat, carbohydrates, salts, and water—that the Scottish nation was celebrated for its vigour of mind and body when oatmeal combined with milk constituted the main sources of its food-supply.

The question also enables a passing reference to be made to

ANOTHER POINT OF EQUAL IMPORTANCE AND INTEREST,

which will be dealt with more fully later on, viz.: that no foods—except sugar, cream, and olive-oil—contain only one class of nutrient. From three to all five of the five classes are represented, though to a very variable amount, in each form of food—bread, meat, or berries, for instance; but, for convenience, it is customary to group each food in the class of which it is the most representative.

Now, we must return to the enumeration of these classes, of which the next in order is the fourth, consisting of *salts* or *mineral matters*, such as iron, potash, phosphorus, lime, and several more. These salts are urgently needed to maintain the health of the body as well as to build its parts. If the supply were to cease, so would life, even though an ample diet in all other respects were provided. It is not, therefore, a matter for surprise that they are found in every form of food eaten by man, as well as in most drinks, water included. Their chief source of supply, however, is in cereals, vegetables, and fruits; hence the stress laid upon the inclusion in the daily diet of cabbage, salads, etc. The adult human body contains about 7 lb. of these mineral matters.

The last, but by no means the least important, class to be mentioned is *water*. About two-thirds the total weight of the body consists of water, so that its claims to constitute a class of food are immediately apparent. Water must be consumed to maintain this proportion as well as to furnish the $4\frac{1}{2}$ pints of fluid, more or less, which are given off daily from the lungs, skin, and internal organs. As the body possesses a very limited capacity to form water in its own tissues, most of its needs must be supplied from its diet. To furnish this supply

ABOUT HALF THE WHOLE WEIGHT OF SOLID FOOD EATEN CONSISTS OF WATER,

besides which another 2 or 3 pints should be taken daily in liquid form, preferably as pure water.

RESTRICTION IN THE DAILY CONSUMPTION OF WATER

means interference with the complex chemical changes always proceeding in the digestive system, muscles, and other parts of the body. When these are interrupted or hindered by an insufficient supply of water, indigestion, constipation, gout, and many other forms of disorder and discomfort occur or are accentuated.

We are apt, too, to ignore the benefit derived by the body from a thorough cleansing within as well as without. A tumbler of hot or cold water drunk on rising in the morning or on going to bed at night is as beneficial to health as the morning or evening "tub." The water washes away and dissolves mucous and other matters in the digestive tube, leaving it fresh and clean for the reception and digestion of the next meal.

A SIMPLE AND OFTEN EFFECTIVE TREATMENT

for occasional attacks of indigestion is to rest the overtaxed organs by abstaining from all food for twenty-four hours, meanwhile sipping a cupful of hot water every two or three hours.

In any case, remember this: that, unless the consumption of water be restricted by doctor's orders, the body benefits by taking at least a quart of fluid a day *as water*, not even in the form of tea, coffee, or cocoa; on the understanding, of course, that the water is pure; or, if the only available source be suspicious, that it is made safe by boiling for from twenty minutes to half an hour.

A little reflection in the light of the information just gained will amply confirm the statement made earlier in this bulletin—namely, that experience has guided healthy human beings to choose just the right forms of food for the upkeep of his body. This fact becomes quite clear when the classes of foodstuffs, with illustrations from their representatives in daily use in our homes, are arranged in tabular form:—

BODY-BUILDING FOODS.

- (1.) *Protein*—Meat, fish, milk, eggs, cheese, peas, beans, etc.
- (2.) *Mineral Matters or Salts*—These are found in all foods, but especially in vegetables and fruits.
- (3.) *Water*—Present in all foods, but needs supplementing in fluid form.

HEAT- AND ENERGY-PRODUCING FOODS.

- (1.) *Protein*—In the foods just enumerated.
- (2.) *Fats*—Of meat, eggs, butter, cream, oil, etc.
- (3.) *Carbohydrates*—Present in cereals, farinaceous foods, most vegetables, and all fruits.

One more explanatory remark is necessary about these classes before passing on to the next part of the subject. Readers will have observed that

PROTEIN APPEARS IN BOTH GROUPS OF FOODSTUFFS,

though it has been mentioned as a body-building food only. The fact is that protein *can* fulfil both these vital functions (another reason for its proud title of "pre-eminent"). But it is rarely relied upon to serve the double purpose of body-builder and energy or heat producer. In the first place, because it is chiefly found in the most expensive kinds of foods—eggs, meat, poultry, etc.; in the second place, because these foods contain their nutrients in very concentrated form; whereas, strange as it may sound, a certain bulkiness in the

diet is essential to the maintenance of health. Before this fact was known repeated efforts were made to supply only highly concentrated food to explorers or to armies on the march, and

MUCH SURPRISE WAS EXCITED

at the disappointing results of the experiments. By degrees these were traced to the detrimental effects of insufficient bulk in the food consumed. This desirable element is furnished by the carbohydrate foods, a fact which will be further explained a little later on.

A very natural question at this stage will be: How has accurate knowledge been gained of just

WHAT SERVICE THESE CLASSES OF FOODS RENDER TO THE BODY?

The part played by these foodstuffs in the nutrition of the body has been quite gradually discovered by close observation and by scientific methods of various kinds, so that to-day, when it is desired to understand accurately the particular worth of any form of food, it is submitted to

FOUR DIFFERENT KINDS OF TESTS,

known respectively as: (1) The chemical; (2) the physical; (3) the physiological; and (4) the economic.

(1.) *Chemical* tests for food-value are designed to discover the exact amount of each nutritive constituent a food contains. The bread, meat, cheese, or other substance is subjected to certain processes which enable the trained worker to separate out the protein or fat or carbohydrate or mineral matters present, no matter how minute a proportion they may form of the whole. In the early days of these chemical investigations into food-values the interesting fact was discovered that *similar constituents to those in man's chosen foods are present in his body*, not, of course, in the form familiar to the naked eye; for the food eaten has to pass through many changes during the intricate process of digestion before it can be carried by the blood and lymph to the bones, muscles, nerves, and various organs the structure of which it maintains.

Fig. (1) gives an idea of the relative amount of each of these five classes of substances which are found in the full-grown body; naturally not massed together as in the illustration, but dispersed in varying amounts and proportions and forms in the different tissues.

Obviously, therefore, it is a matter of importance to supply the right amount of each substance by means of our daily diet, in order to maintain their relative proportions in the body. Too much protein or too little fat might conceivably disturb the balance of health. That is just

THE LESSON MAN IS LEARNING AT SOME COST

and by slow degrees. An excess of protein does not mean an increase of strength or a finer body. Rather it results in disordered nutrition instead of growth; in debility and dyspepsia instead of strength; and if there be too little fat in the diet the deficiency is associated with

MANY FORMS OF ILL-HEALTH;

a tendency to "take cold," or to contract tuberculosis, or to suffer from constipation; to name but a few of the results now known to follow an

Fig. 1.

insufficient supply of this important foodstuff. Before life became so artificial as it is to-day, instinct guided human beings to a surprising degree not alone in the right choice of their foods, but in their correct combination also. Eggs, rich in protein, have been eaten for untold generations with bread, rich in carbohydrates, and butter, a form of pure fat. Some kind of vegetable has been habitually consumed with meat or poultry; beans, rich in protein and carbohydrates, are still allied with fat pork; veal, deficient in fat, is eaten with rashers of bacon; the acid of apple-sauce is a usual combination with the highly concentrated forms of protein and fat found in pork or goose.

THE FAULT OF TO-DAY

lies in the failure to adapt old and often in themselves good customs to modern requirements. Thus the combination and quantity of certain common foods, suitable to a man taking hard exercise or whose consumption is limited by the difficulty of securing much of it, become unsuitable when selected by the sedentary town dweller, or by the man in easy circumstances, who can eat just as much as he likes; which is quite a different thing from just the amount required by his body! This point will be treated more in detail in Part II. Meanwhile, further and fuller reasons must be given why other means

OF ESTIMATING FOOD-VALUES

call for consideration, besides the method of identifying its chemical constituents. Were a housewife to study these only, she might soon find herself in the same plight as a friend of mine, who had listened with great interest to a lecture on

THE CHEMICAL CONSTITUENTS OF OUR DAILY DIET,

from which she learned that cheese and dried cod-fish contain very high proportions of protein (cheese, 35 per cent.; salt cod, 25 per cent.), and that pleasant flavours promote digestion. This lady was most anxious to rear up a family of tall children and loved to consult their tastes whenever possible; so she proceeded to apply to her menus the information thus recently acquired. Soon the doctor was summoned to a houseful of querulous, dyspeptic children, whose mother, full of the best intentions, had been providing a diet in which cheese and salt cod figured daily; and who had permitted unrestricted access to jam and pickle jar, as well as to sauce-bottle, in her desire to please their palates.

Poor woman; she learnt a very sharp lesson on

THE RISKS OF TOO SLIGHT A KNOWLEDGE OF A BIG SUBJECT.

The doctor explained to her that, in the first place, no child under ten or twelve years of age should even know the taste of cheese, salt cod, pickles, or sauces—foods to be eaten at any age with discretion. In the second place, he pointed out that she had gained this imperfect information because she had attended but one lecture of a course. In the succeeding lectures to that to which she went, the lecturer had explained why chemical analysis alone, useful as it is in its place, is an insufficient guide as to the food-value to the human body of the articles eaten at the different meals.

A CHEMICALLY PERFECT FOOD MAY BE IMPOSSIBLE OF DIGESTION

or otherwise unsuitable to the consumer; consequently, great importance is attached by competent authorities to the three other tests just mentioned.

The second of these, namely,

THE PHYSICAL TEST FOR FOOD-VALUES,

will now be discussed. To enter intelligently into the worth of this test readers must be reminded of Professor Chittenden's three great mysteries of life: (1) The power of the body to grow at the expense of the food eaten; (2) the power to renew the worn-out parts of the body by the utilization of the daily diet; and (3) the power to derive energy from this supply to run the machinery of the body, and thus to work.

HOW IS THIS ENERGY DERIVED FROM FOOD?

An engine derives energy from the steam generated by the water in its boiler, which is heated by the combustion of fuel in its furnace. We constantly talk, too, about the body's furnace and how it is stoked by the fats and carbohydrates present in the food we eat; but all the time we realize that what we say is, after all, but a figure of speech. Nevertheless, food *does* seem to warm us up on cold days, when we thoroughly enjoy suet puddings, hot buttered toast, or pork and beans; whereas in warm weather we instinctively turn from these foods and choose fruit, custard, and sponge-cake.

To take another example of what our sensations teach as to the connection between food and energy. Every one has noticed that, when wearied by a long spell of work,

A GOOD MEAL REVIVES US AMAZINGLY

and restores our flagging energies; and we have all experienced at some time or another that when very hungry, even pleasures lose their savour; but soon after taking food a sensation of refreshment is felt and we resume our work or play with renewed zest. There can be no doubt that

FOOD AND ENERGY ARE CLOSELY CONNECTED.

Yea, more than this, food—its sufficiency or deficiency—can and does affect the character and direction of the actions by which energy is outwardly expressed. Have you ever heard that

THE TERRIBLE EXCESSES OF THE FRENCH REVOLUTION

may be attributed to brains disordered by starvation? By one of life's perplexing ironies, this poor, starved people actually guillotined, in their misdirected energy, the great founder of modern chemistry, Lavoisier, who, before his execution in 1794, had fortunately set men on the right road to discover the character of the changes undergone by food in the body, which result to the eater in a supply of energy for work.

Since the days of Lavoisier, the process he dimly perceived has been clearly traced. It is now proved that these changes are brought about by

A PROCESS OF SLOW COMBUSTION,

technically called "*oxidation*," always going on in the liver and muscles. The process does not exactly resemble the rapid combustion, accompanied by

smoke and flame, to which we are accustomed in our stoves; but it is similar in character, though very different in degree. The heat of the body in health rarely exceeds 99° Fahr., whereas that usual in a stove is many times as much; even in an oven attached to a stove the temperature may register 400° Fahr. or more.

Are we not all familiar with the fact that

ONE RESULT OF ACTIVE EXERCISE IS TO QUICKEN THIS PROCESS

of combustion in the body? In cold weather we instinctively run, dance, or otherwise take active exercise to "get warm"; while in hot weather we move about slowly and as little as we can in order "to keep cool." If the body becomes disordered by disease, then combustion may increase too rapidly; the patient "burns" with fever; and if the temperature rise and remain too high he "burns out"—that is, he dies. In an invalid, weakened by long illness, the process of combustion proceeds too slowly; the temperature is "below the normal," blankets and hot-water bottles are needed to keep the body warm enough to live.

SOMETIMES THE FURNACE IS CHOKED WITH IMPERFECTLY CONSUMED FUEL.

The amount of fuel-food eaten has been in excess of the body's needs or unsuited to its capacity for digestion. Measures are resorted to to clear out the accumulation, by means of purgatives or otherwise, while food is temporarily withheld.

Evidently, then, there are many points of general resemblance between the combustion with which we are familiar in engine or kitchen-stove and that proceeding so marvellously within our bodies.

The results of Lavoisier's observations led his followers to make many further discoveries bearing on food as a source of energy to the body. The fact was discovered that

IF A PORTION OF DRY FOOD IS BURNED, IT WILL GIVE OUT A DEFINITE, MEASURABLE AMOUNT OF HEAT.

An ounce of lean meat, for instance, yields just so much heat, an ounce of butter yields so much, an ounce of sugar so much; consequently, their relative worth as sources of heat to the body can be accurately measured; though that is not exactly the point I now want to make, which is this: After a large number of experiments had been made and many years of devoted labour had been expended, the further fact was proved that, when digested, these foods supplied an amount of energy equal to the amount of heat they produced when burned outside the body. The result of all this scientific work is that the energy-value of anything we eat can now be as accurately measured as the weight of flour, sugar, and raisins are measured for a cake or pudding. It is true that

THE HOUSEWIFE USES OUNCES AND POUNDS

as her scale of measurement, whereas the student of food-values uses what he calls "calories" ("calor" is the Latin word for heat) when he estimates how much heat—or its equivalent, energy—is given up to the body by the portion of meat, bread, jam, or fruit consumed at a meal.

An ounce of *fat* measured by this "heat" scale yields more than twice as much heat, and therefore energy, as do similar amounts of *protein* or *carbohydrate*.

WHITE OF EGG IS PRACTICALLY PURE PROTEIN.

If the white of an ordinary-sized egg is burned with proper precautions, it yields 16 calories.

SUGAR IS PRACTICALLY PURE CARBON.

If a small lump be burned, of the same weight as the white of egg, it also measures 16 calories.

OLIVE-OIL IS PRACTICALLY PURE OIL OR FAT.

If a corresponding weight of olive-oil be burned (about a thimbleful), it would yield nearly 40 calories; that is more than twice the amount of heat measured in the other two cases.

It is a sound instinct, then, which impels us in cold weather or when doing hard manual work to eat more fat-containing foods than when sitting quietly at a desk or worktable; or when "melting" with heat at midsummer. A man doing hard, muscular work needs to eat daily food which will furnish him with about 3,000 calories.

TABLE OF NUTRITIVE VALUE OF SOME COMMON FOODSTUFFS.

1 lb. of	Calories a lb.	Refuse, per Cent.	Water, per Cent.	Protein, per Cent.	Fat, per Cent.	Carbohy- drates, per Cent.
Sugar (granulated) =	1,857	..	..	..	..	100
Rice	1,630	..	12.4	7.8	0.4	79
Peas, beans, or lentils, dry	1,590	..	13.2	22.3	1.8	59.1
Meats (about)	928	12	55	16	15	..
Fish (fresh)	388	30	45	12	4	..
Milk	325	..	87	3.3	4	5
Potatoes	325	15	67.1	1.8	0.1	15.3
Bananas	290	40	44.5	0.7	0.5	13.7
Apples, grapes, etc...	285	25	60	1	0.9	12.9

A LUMP OF BLUBBER AFFORDS AS KEEN PLEASURE TO AN ESQUIMAUX CHILD

as does a stick of chocolate to one of our own small folk or a banana to a little blackamoor in the Tropics, because it lives in an intensely cold climate and its body-furnace calls for more vigorous stoking. How is it, then, that few people can take fat in any quantity, if it is so useful as a source of heat and energy to the body?

The answer to this inquiry is found in the fact that

FAT IS MORE DIFFICULT TO DIGEST,

and takes longer to undergo the series of changes necessary before it yields energy to the body, than is the case with foods containing protein or carbohydrates; so we find that mountain-climbers, harvesters, or men on a long march, eat, by preference, chocolate, preserves, or molasses in large quantities; because sugar undergoes more rapid combustion in the liver and muscles than fat does; thus the energy it yields is more quickly available to meet any unusual call.

CAUTION.—Do not hastily conclude that our consumption of sugar may be unlimited, or that the more sugar we swallow the higher will be the degree of energy we attain.

More information on this point will be given later on; meanwhile remember the profound truth of St. Paul's behest "to be temperate in all things."

MAKE A MENTAL NOTE OF THIS FACT, HOWEVER:

The starved or ill-nourished individual is incapable of good or prolonged work, mental or physical, because he is insufficiently supplied with the fuel-food which constitutes the foundation of bodily energy. Here is a good illustration of the fact:—

Concern was excited, some years ago, by the poor physical condition of the children at the Duke of York's School in London, an asylum founded for the orphans of soldiers. The fault lay partly with the overcrowded dormitories, partly, it was thought, in the prolonged hours spent in school. More sleeping accommodation was provided and book-learning was reduced, one-half of each day being given to manual training in workshops and to physical drill. Imagine the committee's disappointment when

THERE WAS AN IMMEDIATE FURTHER DROP IN THE AVERAGE HEIGHT AND WEIGHT

of the already undersized and delicate children, who seemed, in some way, conscious of their deficiencies, for, out of 460 boys, eighty besieged the dispensary every day, asking for cod-liver oil. No pains were spared to discover where the error lay in their management; and at last the true cause was found.

The children were being called upon for an amount of work quite beyond their strength, and certainly beyond the energy furnished to them in their diet. Calculation showed that

THE ENERGY-PRODUCING FOOD SUPPLIED WOULD SUFFICE FOR ONLY HALF THE AMOUNT OF WORK DEMANDED OF THEM.

The boys were getting too little body-building material and too little fat. The little fellows begged for cod-liver oil, not alone for its own sake as a fuel-food (though naturally they were ignorant of this technical fact), but because a slice of bread and butter was usually given with it!

Directly an adequate diet was supplied the cod-liver-oil appetite vanished, and the children gradually gained in health and energy.

Readers may be interested to know, by the way, that

THE AMOUNT OF WORK DONE BY THE BODY CAN BE AS ACCURATELY MEASURED AS THAT DONE BY A MACHINE.

When this calculation has been made, it becomes comparatively easy to estimate just the amount of fuel or energy-producing food needed by the worker. Be pleased to note, however, the precaution exercised by the word "*comparatively*." The reason for its use leads us on to the third and most important test of all for food-values, viz.:

THE PHYSIOLOGICAL TEST.

This test approaches the subject by putting the following series of searching questions to every foodstuff, or food-fad, or much-advertised patent preparation, as it passes them in review:—

(1.) How does it behave in the stomach and intestines?

(2.) Is it easily digested?

(3.) To what extent is it absorbed?

Truly has it been said that

WE LIVE, NOT BY WHAT WE EAT, BUT BY WHAT WE ABSORB.

Chemical analysis may show a substance to contain just the right proportions of protein, fat, or carbohydrates; it may yield a satisfactory degree of energy in the process of slow combustion; but, unless it is easy of digestion and unless its nutritive constituents can be absorbed by the blood, it is valueless as food.

SAWDUST, PETROLEUM, HOOFF-PARINGS,

for example, can pass the first and second tests triumphantly; but they fail to fulfil either requirement of the third—they can neither be digested nor absorbed.

What is the distinction, you will inquire, between these two

PROCESSES OF DIGESTION AND ABSORPTION?

In the first place the digestion of food *must* precede its *absorption*. The several stages of digestion may be roughly outlined as follows; they are far too complicated and elaborate to be described in detail in popular language:—

- (a.) The selection of suitable food in market or store. Dirty, stale, diseased, bruised, or “sophisticated” foodstuffs should be rejected.
- (b.) The proper preparation of the chosen food in the kitchen, either by cleansing, manipulation, or the application of heat. (*See Bulletin 36.*)
- (c.) Thorough mastication of the food by the teeth; a process of crushing and grinding, by which nutritive constituents are set free and large surfaces are formed, upon which the digestive secretions may act. To “bolt” food is to remain unfed and cruelly to irritate the organs of digestion.
- (d.) The swallowing of the food and the passing of it on to organs and secretions thenceforth *beyond* our control, but the efficiency of which are much influenced by a process entirely *under* our control—namely, sufficiently prolonged mastication.

Every one ought to know that

PROPERLY CHEWED FOOD

stimulates the stomach to perform its part efficiently in this marvellous process of digestion. Similarly, while the stomach is accomplishing its own task in masterly fashion, it incites the intestines and pancreas (sweetbread) to an equally high standard of performance. If

THE WHOLE SEQUENCE OF EVENTS

is to be perfectly carried out, no detail must be slurred over or omitted, otherwise the succeeding stage of nutrition cannot be successfully accomplished. Fortunately, therefore, Nature has kept the greater part of the prolonged process of digestion in her own hands. Were it entrusted to us it would not be half as well performed; indeed, just as soon as we concentrate our attention upon one or other stage of the journey taken by our food through our bodies, just so soon is the stage interrupted and all sorts of accidents occur.

Have you ever heard that

EVERY PARTICLE OF FOOD CONSUMED,

whether it be a spoonful of milk-pudding or a hard cracker, must assume a *fluid form* before it can serve the body as nourishment? Digestion is largely a process of *liquefaction*, and the change has to take place somewhere between the lips and the marvellous surface of the small intestine, which absorbs and passes these fluids through its own substance to the blood and lymph which bathe every portion of the muscles, nerves, bone-cells, etc., of which the body is built up.

The long tube, which extends from the mouth right through the trunk, in which digestion takes place, is, virtually, as much cut off from direct communication with the lungs and heart, for instance, or with the limbs, as if it were completely outside instead of inside the trunk. Consequently,

THE WELFARE OF THE WHOLE INDIVIDUAL

depends upon—

- (a.) The reduction of nutrient material to fluid form within this tube:
- (b.) Upon the efficiency with which it is absorbed and distributed to the different tissues, which call for repair or energy.

If the food is by its nature incapable of digestion, as, for example, the skins, stones, and seeds of fruit and vegetables; or if the surface of the intestine is unequal to its work, as in cases of cholera or typhoid fever; or if the eater is worried or plunged into profound thought, so that an unusual amount of blood is busy in the brain; or if he is overtired, so that the blood and nerves are half poisoned by the chemical results of great fatigue—then no absorption is possible, and all sorts of miseries, known as indigestion, are the result.

NOW FOR A WORD OF GOOD ADVICE.

If the appetite fails, do not hurry to force it; just go without eating until hunger returns. No healthy person suffers from occasional absence of all food, except water, for twenty-four to thirty-six hours. Hunger is the body's cry for food; when it wants nourishment, hunger makes itself felt. A loss of appetite in a healthy, well-fed person usually means that too much food or food of an improper kind has been eaten; or maybe the eater was overtired, worried, overexcited, or otherwise incapable of making use of the food he forced down, thinking it the right thing to do.

FOLLOW NATURE'S LEAD,

and do not force food on the unwilling digestive organs; they will ring an insistent dinner-bell when ready for work. Of course, if illness be the cause of loss of appetite, then the form and frequency of the diet is a matter for the physician to decide.

It may be useful here to mention another important fact. Readers may be puzzled over

THE APPARENT INCONSISTENCY

of insisting that all food must be well absorbed and yet saying (on page 11) that unless some indigestible material be eaten, such as cellulose, constipation

follows, with all its long train of disagreeable companions. The fact to which attention is now to be drawn reconciles these two apparently contradictory statements. In describing meat as rich in protein or bread as a carbohydrate food, it is not meant that these foods contain *only* protein or *only* starch. In almost every case these nutrients are combined with a greater or less amount of the other four classes of nutritive substances as well as with cellulose or similar indigestible fibrous matters, from which it is the work of the digestive organs to separate them. The residue remains in the intestine to serve the purpose of "ballast," which, in the course of its expulsion from the intestine, carries with it other undesirable products, which have accumulated in the process of digestion.

Let us suppose that a man requires $4\frac{1}{2}$ oz. of protein to repair the daily wear and tear of his body; he could find no foodstuff in which this protein occurs in pure uncombined concentrated form. He would have to eat $1\frac{1}{2}$ lb. of meat, for instance, in order to get his $4\frac{1}{2}$ oz.; or if he preferred eggs and milk, he would have to drink two quarts of milk and eat nine eggs! Of course, such a diet is mentioned only to illustrate my point, not as an example to be followed. Once more it must be emphasized that

THE METHODS OF EXPERIENCE

find full confirmation when subjected to the tests now under consideration in respect of food-values. A healthful diet must be a mixed diet; then the excess of a particular nutrient in one article, such as protein in meat or fish, is balanced by the high proportion of starch in another, such as potato or rice; or of fat in another, such as butter. Part II. will deal more at length with this matter of the constituents and combinations of foods in common use, but, just in passing, mention may be made of another interesting fact—namely, that after the first two or three years of life, the nutritive substances in milk and soup are better absorbed when bread is eaten with them than when taken alone.

Another factor of physiological importance must not be overlooked; it is that of

INDIVIDUAL TASTES OR DISLIKES IN FOODS.

This is a matter which materially influences the absorption of food. There is profound truth in the old saying that "One man's meat is another man's poison." The food which makes your mouth water, for instance (a good omen for its digestion, by the way), may leave mine unaffected or even seem to parch it up, so objectionable to me is your favourite dish.

Eggs are actual poison to some luckless individuals, just as mutton occasionally produces nausea in others, or shell-fish may be the cause of nettle-rash. A sufferer from severe asthma has been known to enjoy freedom from this distressing complaint after a supper of lobster salad, while tortured for hours after a meal of boiled fish. Generally speaking, food hated is food wasted.

Food has been compared by one writer to ore, and the nutrients it contains to the precious metal concealed within the ore. Digestion is the process by which the body secures these hidden treasures. The *chemical* test tells us how much metal is present in a given mass of ore. The *physiological* test shows whether the body *possesses the machinery or tools necessary to extract and utilize it.*

The fourth and remaining test to be discussed is

THE ECONOMIC TEST FOR FOOD-VALUES.

It concerns itself with—

- (1.) The price we pay for our foods;
- (2.) The amount of them we waste; and
- (3.) Their management in the kitchen.

Professor Atwater used to say that for persons in good health, foods in which the nutrients are most expensive are like costly jewels. People who are well off may be justified in buying them, but they are not economical.

Besides getting good value for our money by an understanding choice of foodstuffs, we ought to check extravagance along two other lines. Many of us eat more than we want, or, rather, more than the body needs, and there is often careless waste of food.

THE THRIFTY HOUSEWIFE

will constantly ask herself: "Are the nutritive substances contained in the food I should like to buy worth the price asked? How much energy will be furnished for that sum; how much building material will it supply?" To quote Professor Atwater again: "There is no more nutriment in an ounce of protein or fat of the tenderloin of beef than in that of the round or shoulder." . . . "A quarter of a dollar invested in the sirloin of beef at 22 cents per pound pays for one and one-seventh pounds of the meat with three-eighths of a pound of actually nutritive material. This would contain one-sixth of a pound of protein and one-fifth of a pound of fat, and supply 11,120 calories of energy. The same amount of money paid for oysters at the rate of 50 cents per quart brings two ounces of actual nutrients; an ounce of protein and 230 calories of energy. But in buying wheat flour at \$7 a barrel, the 25 cents pay for six and a quarter pounds of nutrients, with eight-tenths of a pound of protein and 11,755 calories of energy."

BREAD IS UNQUESTIONABLY THE CHEAPEST FORM OF FOOD

where energy is concerned. It will furnish *for the same cost* three times the amount of energy which would be obtained from milk or ten times as much as could be got in the form of meat *for that amount of money*. If building material is in question, peas rank first as a source of cheap supply. They work out at about half the cost of cheese. Were an equal expenditure made on both foodstuffs, peas would keep the body in repair for two days, while there would be only enough protein in the cheese for one day's requirements.

But, because cheaper to buy and chemically satisfactory as regards their nutritive constituents,

PEAS ARE NOT THEREFORE SUPERIOR TO CHEESE

as builders-up of the body. It must be borne in mind that each test has to be passed by the particular foodstuff under consideration before its order of merit can be conferred. There are two drawbacks to peas. They call for prolonged cooking, and their nutrients are difficult for the digestive organs to extract and for the tissues to absorb. A large quantity must be eaten to furnish all the body needs. Cheese, on the contrary, need not be cooked and is highly concentrated; but here lies another pitfall, cheese is unsuitable as a food unless five or six times its bulk of bread or cracker or biscuit is eaten with it to furnish the requisite bulk.

VEGETABLE FOODS,

which consist chiefly of starch and sugar, are far cheaper than are animal foods, of which the protein value is high. For this reason, it is fortunate that from four to five times as much carbohydrate is called for in our daily diet as of the more expensive proteins and fats. But, unfortunately,

THERE IS A GENERAL TENDENCY TO EXAGGERATE

these relative proportions in favour of the less expensive and often more attractive carbohydrates. Few people can resist the enticements of cakes, puddings, candies, or fruit, and eat them in excess of their requirements. The point cannot be too strongly emphasized that, if in comfortable circumstances, we constantly

EAT TO PLEASE OUR PALATES AND CHOOSE OUR FOOD ACCORDING TO THE LENGTH OF OUR PURSES,

not from an intelligent sense of what is best for us or of true economic worth. The market price of food is no guide to its real money or food value. When we eat an egg for which we have paid more than 2 cents, we pay for the pleasure it gives us to eat it; for its food-value is in no way commensurate with its cost, when that cost ranges from 4 cents to 6 or more cents an egg.

Then, too,

THE WASTE FROM BAD COOKING AND SERVING

or from bad combinations of foods must be taken into account, for it opens up a huge economic question. Kitchen and table refuse is not total loss in the country, for it goes to pigs and poultry, bringing compensation in the form of pork and eggs. But in cities the material thus wasted has been found to amount to one-ninth of the food bought, and that the most expensive ninth. For analysis has shown that such wastes consist usually of about one-fifth of the protein and fat-containing foods, which, as we have learnt, are the most costly which appear on our tables.

IF THE FOOD WASTED IN AN ORDINARY HOUSEHOLD

were collected over a period of one month and then displayed before the family's eyes, much horrified surprise would be experienced. Careless leavings on plates, unpalatably prepared dishes or unappetizing modes of service, would account for most of this accumulation; but it is also to be wished, though, alas! vainly, that such a convincing method of conviction were also possible with the "overeaten" food swallowed, which is just as much wasted!

A NOTED ENGLISH PHYSICIAN,

who was a profound student of this subject of food and diet, wrote as follows: "I have come to the conclusion that more than half the disease which embitters the middle and latter part of life is due to *avoidable* errors of diet . . . and that more mischief *in the form of actual disease*, of impaired vigour, and of shortened life accrues to civilized man . . . from erroneous habits of eating than from the habitual use of alcoholic drink, considerable as I know that evil to be."

PROXIMATE PRINCIPLES OF FOODS.

ANIMAL.

MEAT-----

FISH-----
 { White-----
 { oily-----

EGGS-----

CHEESE-----

MILK-----
 (about 87 per cent. Water)

VEGETABLE.

BREAD(White)-----
 (About 100 per cent. Water)

LENTILS-----

POTATOES-----

FRUITS (Fresh)-----

NUTS-----

BODY-BUILDING and FLESH-FORMING.

Proteids---

HEAT and ENERGY-GIVING.

Starches & Sugars---
 (Carbohydrates)
Fats---

Fig. 2. Reproduced by kind permission of Messrs. E. J. Arnold & Sons, Ltd., Leeds, England.

References to our tendency to

OVER-EAT CARBOHYDRATE FOODS

have been so frequent (bread, cakes, biscuits, farinaceous puddings, cereal preparations, and candies) that the minute quantity of this nutrient stored in the human body—*see* Fig. (1)—will excite some curiosity. What becomes of all the starch and sugar consumed daily in every household?

If only the *correct* amount of these carbohydrates is taken in the course of the day, it is used right away by the muscles to supply the energy they need for their constant activities. Very little of this rapidly consumed form of fuel remains over. Should more fuel be called for unexpectedly, there is a reserve of fat, some of which can be employed for the purpose, until the next stoking with carbohydrates takes place.

AN EXCESS OF STARCHES OR SUGAR

clogs the machinery of the body with half-consumed fuel and loads it with much unwholesome, watery fat, which interferes with the harmonious working of its parts; just as a fire is choked with half-burnt wood and ash cannot burn brightly until the ashes have been raked out. A body overloaded with fuel-food is hampered in its work, even damaged, by a surfeit of candies or an excess of cakes and tarts.

IF AN ENGINE HAS TO PUT ON A SPURT,

fuel is piled on to its furnace; so, if we are taking much exercise, more carbohydrates are allowable, indeed necessary, to supply the extra demand for fuel; and we can indulge, though always with reason, our taste for sweet things; but when confined to the house by the weather or other causes, or when on the shady side of fifty, when we expect a certain amount of waiting upon from our juniors, good sense dictates reduction of carbohydrate food.

HOW ARE WE TO JUDGE WHAT IS THE CORRECT PROPORTION OF THESE DIFFERENT FOODSTUFFS

which should be consumed at different times of life, and by what considerations should our daily diet be guided? These questions are of great importance and call for careful answers. As we have now learnt, much light has been thrown by chemical analysis upon the proportion of each nutrient contained in our common foods. A useful, working knowledge of some of these will be gained from a study of Fig. (2). Observe that the protein present in animal foods is always combined with more or less fat. In some cases the amount is very small, as in white fish, for instance. (Note,

THE GENERAL CUSTOM

of eating melted butter with whiting or halibut to make good this deficiency.) In cheese, however, there is as much fat present as protein. That there is actually a little fat in bread and potatoes will occasion some surprise; and very few people realize how much fat there is in an egg. As a matter of fact, the form of fat found in an egg is peculiarly easy of digestion; hence one of the reasons why eggs are so generally recommended for invalids and young children. The traces of fat in bread and potatoes are too small to be taken into account in our diet.

MORE SURPRISING STILL IS THE FACT

that potatoes and fruit contain protein. Potatoes contain just over 1 per cent. of protein, so much of which is habitually lost owing to careless peeling and cooking that it has been calculated that the loss of this nutriment from a bushel of potatoes, peeled and soaked before cooking, is about the equivalent of a pound of beef-steak. Consequently, the careful housewife and intelligent cook steam or otherwise prepare potatoes "in their jackets," that "nothing be lost."

Apricots, strawberries, grapes, raspberries, and bananas all contain about 1 per cent. of protein; while in dried fruit the amount varies from 5.5 per cent. in figs and 4.4 per cent. in dates to 2.5 per cent. in prunes and raisins. This explains why these dried fruits form so usual and sufficient a substitute for meat in hot climates, such as Arabia, where meat is either difficult to procure or to keep wholesome for even a few hours, owing to the intense heat.

THE LARGE AMOUNT OF FAT IN NUTS

will also excite interest. When thoroughly chewed or ground in a machine, nuts are among our most nutritious foods; for which reason they are a fruitful source of indigestion when eaten at the close of a full meal or at odd moments during the day.

The *average* composition of nuts, such as walnuts, chestnuts, almonds, filberts, etc., is as follows:—

Protein	15 to 20 per cent.
Fat	50 to 60 "
Carbohydrates	9 to 12 "
Salts	1 "
Water	4 to 5 "

What further do nuts contain, you will ask, to complete the hundred parts? The question is most timely, for it enables reference again to be made to the substance—*cellulose*—found in all vegetable foods; a substance which, though wholly indigestible, is nevertheless of great importance and value, for cellulose is the "ballast" mentioned on page 20. It is a fibrous substance, which serves as a framework to support the juices, rich in carbohydrates and salts, of which the bulk of vegetables and fruits are composed.

THE DELICATE, TISSUE-PAPER-LIKE SUBSTANCE

remaining in a "squeezed" lemon is cellulose. It encloses, fragile as it appears, all the nutrients in this class of foods, and locks them most effectively away from the digestive juices, unless the framework be broken down and crushed by the teeth or softened by cooking or by acids, such as vinegar. It is for this reason that old or slowly grown vegetables call for prolonged, slow cooking, as these cellulose envelopes have become toughened and almost woody in consistency. Under any circumstances, this framework is particularly dense in nuts, which is another reason why they are so generally difficult of digestion. A third cause is found in their high proportion of fat, and a fourth in their extreme concentration.

All the same,

THIS FACT MUST NOT BE LOST SIGHT OF:

Indigestible as cellulose is, it constitutes, if well chewed and well cooked, a most important element in our diet. Food, such as eggs or milk, which can be almost entirely absorbed, results in constipation, because there is not enough

bulky residue left in the intestines to excite them to expel the undesirable matters, which accumulate after nutrients have been absorbed in the process of digestion. Oatmeal, green vegetables, whole-meal bread, fruits, etc., are prescribed for this trouble, because they leave a relatively large amount of this desirable "ballast," which, as it is pushed along by the worm-like movements of the intestine, carries with it matters, minute perhaps in bulk, but highly injurious to the health, if allowed to remain in the bowels, through the delicate lining of which they are liable to be absorbed into the blood; hence

"BILIOUS ATTACKS," SKIN-ERUPTIONS, LEADEN-HUED SKIN,

and other indications to the trained eye of self-poisoning, technically called "auto-intoxication." But again a caution is necessary. Valuable to health as is this bulkiness of vegetable foods, it becomes a disadvantage if these be taken to excess; for then the nutrient substances, always more difficult of digestion and absorption when eaten in vegetable form, may be so rushed along, owing to the stimulating effect of this class of "ballast" upon the intestine, that there is not time for the process of absorption to be completely performed, and the eater suffers from insufficient nutrition.

MAN IS DESIGNED TO EAT A MIXED DIET,

and in temperate climates he is at his best when he eats about one part of animal food to four or five parts of vegetable.

Attention must now be directed to Fig. (3), for it emphasizes several of the facts which bear most materially upon

THE SUBJECT OF APPROPRIATE FOOD.

The series of figures, from 0 to 80, which run along the top and bottom of this diagram, represent the years of age from birth onwards; while the Roman numerals at each side refer to the amount of food (in ounces) which is required by the healthy human being during these years.

The lowest curve of the three represents the quantity of fat which should be included in the daily diet, the middle curve demonstrates the quantity of protein necessary, and the upper curve indicates the proportion of carbohydrate, shown by experience, to be desirable at the different age periods.

It will be seen that at birth the three classes of foodstuffs are called for in equal amount, hence milk—*see* Milk in Fig. (2)—is the sole and appropriate form of food for the infant. But each year a greater divergence occurs in the three curves. More protein is wanted than fat, and, as muscular activity increases, the demand for carbohydrates increases out of all proportion to the increase of the other two nutrients, which maintain a fairly close relationship throughout life.

NOTICE THE ALMOST ABRUPT UPWARD COURSE

of each curve until the year 24 is reached, the age when growth is practically complete. Then, with one consent, each curve begins to decline; though, be it observed, not in the same proportion, and in a very gradual, long-drawn-out fashion.

What does all this signify? How does it concern the housewife? Is it not rather a matter for the medical man or the scientific worker than for us, every-day sort of folk?

These questions shall receive replies in the same order as that in which they have been put. The lesson taught by this diagram is the significance

throughout life of food suited to the eater. It is a vital matter that our diet be adapted to our age, both in quantity and quality. The appalling annual loss of infant life is an object-lesson of this fact. Feed an infant in accordance with the Law of Nature, and it survives almost any kind of ill which may befall it. Neglect this law, and no human skill, no exquisite climate, no expenditure of money, will rear it to maturity.

The small child and the grown man, the youth and his grandfather, each need varying amounts and proportions of food. To overfeed old age is to shorten and to sadden the declining years; to underfeed youth is to warp and check the normal course of development.

PROVISION FOR GROWTH AND FOR WARMTH

are the urgent requirements of the new-born child. Protein and fat are therefore of primary importance. Not much sugar or starch are needed, as during the first six or nine months of its life the infant leads, or should lead, an almost vegetable existence; sleep, warmth, and food fulfil its demands, which should be met with machine-like regularity. With the development of a more active phase of life a diet of different proportions is required. The addition of crisped bread, of a lightly cooked egg, and other suited foods, such as farinaceous puddings, white-fish, later on poultry and certain kinds of stewed fruit with cream, gradually train the child's digestive organs while meeting his bodily needs, until, by the age of seven or eight years, a healthy child will be eating much the same food as its parents, only with a larger proportion of milk, and generally of a simpler character.

The teachings of this diagram concern the housewife most nearly, because it is she who must provide for these ever-changing requirements. Not, of course, that any one suggests the making of elaborate calculations daily; or that the attention of the family should be concentrated upon the varying proportions of nutrients desirable under varying conditions. But every intelligent woman must familiarize herself with the broad principles which govern healthful feeding at each age period, and apply them to the best of her ability. For this is a question of efficiency, and of the courage, the cheerfulness, and the love of work associated with good nutrition.

NOW THAT THE FACTS ARE KNOWN,

it becomes a duty to make use of them. Otherwise man cannot do his full or best work in the world; he cannot serve his country or his empire to the degree of which he should be capable; he cannot play his part in the progress of civilization; he cannot become the parent of healthy children; he cannot enter fully into his heritage of culture, of experience, of world-wide knowledge.

With the object of equipping the housewives of this Province with that "working knowledge" of intelligent feeding to which repeated reference has been made, Part II. of this bulletin will be devoted to the practical applications of the theoretical information furnished in these pages.

ALICE RAVENHILL,

*Fellow of the Royal Sanitary Institute; Certificated Lecturer
National Health Society, Great Britain and Ireland.
Author of "Practical Hygiene for Use in Schools";
"Elements of Sanitary Law"; "Some Characteristics
and Requirements of Childhood"; "Household Admin-
istration"; "Household Foes," etc.
Late Lecturer on Hygiene, University of London, King's
College for Women.*

NOTICE.

The Department of Agriculture is issuing the following series of bulletins prepared by Miss Alice Ravenhill, Shawnigan Lake, B.C., to be available for distribution among the members of the Women's Institutes throughout the Province:—

- No. 1. The Place and Purpose of Family Life.
- „ 2. The Preparation of Food.
- „ 3. The Preservation of Food.
- „ 4. Labour-saving Devices in the Household.
- „ 5. Food and Diet—Parts I. and II.
- „ 6. The Art of Right Living.
- „ 7. The Care of Children.

BULLETINS ISSUED BY THE DEPARTMENT OF AGRICULTURE.

- No. 7. Flax.
- „ 8. Feeding Farm Animals.
- „ 20. Varieties of Fruit Recommended. (Revised.)
- „ 25. Orchard Cleansing.
- „ 28. Production of Eggs.
- „ 29. Poultry Industry on the Pacific Coast.
- „ 30. Guide to Bee-keeping in British Columbia.
- „ 32. Control of Bovine Tuberculosis in British Columbia.
- „ 33. Fruit-growing Possibilities, Skeena River and Porcher Island Districts.
- „ 34. Fruit-trees and Black-spot Canker.
- „ 35. The Place and Purpose of Family Life.
- „ 36. The Preparation of Food.
- „ 37. The Preservation of Food.
- „ 38. The Construction of Silos.
- „ 39. Natural and Artificial Incubation and Brooding.
- „ 40. Alfalfa.
- „ 41. Labour-saving Devices in the Household.
- „ 42. Apiculture in British Columbia.
- „ 43. Women's Work in British Columbia.
- „ 44. Irrigation in British Columbia.
- „ 45. Agricultural Statistics, 1911.
- „ 46. Food and Diet—Part I.

Applications for bulletins published by the Department of Agriculture should be addressed to the Secretary, Department of Agriculture, Victoria, B.C.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1912.

PROVINCE OF BRITISH COLUMBIA.

DEPARTMENT OF AGRICULTURE
(WOMEN'S INSTITUTES).

BULLETIN No. 47.

FOOD AND DIET PART II.

—BY—

MISS ALICE RAVENHILL,
Fellow of the Royal Sanitary Institute, etc., etc.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1913.

PROVINCE OF BRITISH COLUMBIA.

DEPARTMENT OF AGRICULTURE
(WOMEN'S INSTITUTES).

BULLETIN No. 47.

FOOD AND DIET: PART II.

—BY—

MISS ALICE RAVENHILL,
Fellow of the Royal Sanitary Institute, etc., etc.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.

1913.

DEPARTMENT OF AGRICULTURE,
VICTORIA, B.C., June, 1913.

*The Honourable Price Ellison,
Minister of Agriculture.*

SIR,—I have the honour to submit herewith Bulletin No. 47, entitled
“Food and Diet, Part II.,” prepared by Miss A. Ravenhill, F.R.San.Inst.,
on behalf of the members of the Women’s Institutes.

I have the honour to be,

Sir,

Your obedient servant,

WM. E. SCOTT,
*Deputy Minister of Agriculture,
Superintendent of Institutes.*

FOOD AND DIET:

PART II.

THE quality and sufficiency of diet," writes one of the leading authorities upon the subject of human nutrition, "has a far-reaching influence upon the development of the race, an influence which is directly seen in the physical well-being associated with an adequate supply of suitable food. The

"PROGRESS OF ANY NATION WILL BE HAMPERED

if its citizens are ill-fed, for upon food depends not only life itself, but the power to work and to resist disease. Further, the development of the race is indirectly affected by diet, through the sharpening of the wits and the social co-ordination which arise . . . from the necessity for the provision of food. For the supply of food depends upon the exertions of the individual and its regular distribution upon the organization of the race."

TO THE THOUGHTFUL READER OF THESE FORCEFUL WORDS

it must seem a strange oversight that, for several centuries, the provision of daily food was considered of small account; a burden to be loaded on to any shoulders rather than those of the mistress of the household; an occupation which called for supervision, it is true, but which was quite capable of performance by any uneducated woman. It was not until philanthropists began to realize that

THE CAUSES OF ILL-HEALTH EXIST CHIEFLY IN THE MISMANAGEMENT OF THE BODY

and in neglect of its needs, that the connection between food and efficiency was discerned. Even then, when the first stir was made, some forty years ago, to provide definite training in the art of cooking, with a view to the betterment of the national health, such instruction was only considered necessary for the poorest and most youthful females of the community (small girls of eleven in the public schools). Several more years elapsed before the mere preparation of a few cheap and simple dishes was supplemented by some teaching on the constituents of food and their relative value to the body, or was extended to the better-off and more favourably situated members of society, who were practically as ignorant of the subject as their poorest neighbours.

DURING THE LAST QUARTER OF A CENTURY,

as the intimate relation of food to health has been more and more realized, painstaking and accurate investigations have been carried out, with the result that much evidence is now available to confirm the statements just quoted, namely, that upon the character of our nutrition, as furnished by our daily diet, depend:—

- (1.) National progress:
- (2.) Power to work:
- (3.) Ability to resist disease.

Records of the past bear witness to the fact that, although scientific confirmation of their observations was not at their disposal, as it is at ours, yet, among the ancient nations—Assyrians, Persians, Egyptians, Greeks—the careful feeding of their young people was directed and sometimes even undertaken by the State itself.

IN THOSE FAR-OFF DAYS,

when the offices of priest, physician, and lawgiver were closely linked (often, indeed, united in one man), strict regulations, associated with religious observances and characterized by direct hygienic intention, were commonly made on the subject of food and diet: witness the strict tenets of the Mosaic laws and corresponding precepts laid down on the subject by Buddha and Zoroaster.

WOMEN OF ALL RANKS,

but more especially those at the head of large establishments, gave much time to acquiring a knowledge of all the processes then in use for the preparation of food until late in the mediæval period; and combined therewith a study of the utilization of herbs and simples for the preservation of health and the healing of disease or wounds. A gradual growth of contempt for

THIS KNOWLEDGE AND THE ART OF ITS APPLICATION

seems to have gone hand-in-hand with the Puritan reaction from the self-indulgent excesses of the sixteenth and seventeenth centuries, when any pleasing of the palate or consideration of personal likes or dislikes were distrusted as a temptation from the Evil One; so that the preparation of the family food was by degrees handed over to the untrained helper or the hired girl. Poor human nature has

PAID ALMOST AS HEAVY PENALTIES

for the effects of this exaggerated disdain of its physical requirements as it has done for the intemperance and debauches of other generations. It devolves upon us to see to it that this twentieth century should be distinguished by a happy mean in its methods, which under wise and skilful direction should be free alike from undue luxury or from injudicious asceticism.

THE MODERN HOUSEWIFE

has abundant opportunities, by means of the press, useful publications, women's institutes and congresses, to sharpen her wits upon the whetstone of sound theory; while as a result of social progress, in the form of ever-increasing, highly organized and cheaper means of rapid communication with other countries, the resources of practically the whole world are at her disposal for the furnishing of her table.

THE TOOLS OF THE MODERN HOUSE-MOTHER

are interest and observation, right knowledge and its constant application. By taking advantage of every opportunity to utilize and improve these tools, she can make good, in a large measure, her deficiency of definite training; which, meanwhile, she will take care her daughters shall enjoy. In the first place, she must bear in mind that

(1.) THE FUNCTIONS OF FOOD AND DRINK

are to build and repair the body, to supply it with heat and energy and generally to maintain it at a high pitch of efficiency. In order to ensure that these functions of food are fulfilled, she must remember, in the second place, that

(2.) ALL FOOD MATERIALS

are composed of one or more nutrient substances, known as protein, fats, carbohydrates, mineral salts, and water. But as

(3.) NO ONE FOOD MATERIAL

contains these nutrients in exactly the proportions required by the body, she must, in the third place, remind herself that a *mixed diet* has been proved by experience to be necessary to health. Consequently, if she be a careful and observant house-keeper, she will use her wits so

(4.) TO GROUP HER DISHES AT EACH MEAL IN THE DAY

as to supply, so far as possible, the right proportion of nutrients to the various consumers. Further, she must seek information, if she does not already possess it, as to the best way to present these nutrients, in order that they shall be suitable to:—

- (1.) The time of day:
- (2.) The season of the year:
- (3.) The age and state of health of the eater:
- (4.) The occupation of the eater:
- (5.) The idiosyncrasies of the eater.

At first sight, these requirements may appear to involve

IMPOSSIBLE AND UNHEARD-OF TROUBLE.

What overwhelming demands are made upon time, for instance, if no one kind of food or combination of foods is adapted to people of different ages, or even for the same person under different circumstances. But such fears are exaggerated.

THE MASTERY OF A FEW GUIDING PRINCIPLES,

applied by well-sharpened wits, will render the provision of a wholesome daily diet for an average family a pleasure, not a penance; and will lend new interest to daily doings.

The first demand of the learner will be for precise directions. "Please furnish me with a specimen correct diet." Well, here are three examples of

THE AMOUNT AND RIGHT PROPORTIONS OF FOOD

for a healthy, middle-aged man to eat in one day. In each case there is about one part of protein to four or five parts of fat and carbohydrate, which are the proportions of body-builders and heat and energy producers shown by experience to suit most people; they also yield the amount of heat (measured, as you will remember, by calories) which is necessary for a good day's work. When put before us in this form, these new requirements will appear less exacting and more familiar:—

DIET I.

13 oz. beef-steak.
3 oz. butter.
6 oz. potatoes.
22 oz. bread.

DIET II.

4 oz. sausage.
14 oz. codfish.
2 oz. butter.
1 pint milk.
3 oz. sugar.

5 oz. beans.
2 oz. rice.
16 oz. potatoes.
9 oz. bread.

DIET III.

10 oz. beef.
6 oz. ham.
2 eggs.
2 oz. butter.

1 pint milk.
12 oz. potatoes.
9 oz. flour.
1 oz. sugar.

Obviously such an amount of solid food as appears in each diet (about 3 lb.) could not be eaten all at once. Hence our custom of dividing it into three meals a day.

Obviously, also, the first diet is the least attractive of the three.

The variety offered by the second and third would be far more appetizing; and, as a matter of fact, the cost in cash of these two amount only to about 5 cents more than No. I.; though, of course, their choice and preparation would call for more time.

Obviously, again, such an amount of food would be too much for some men and perhaps too little for others. It would depend upon their build, their occupation, and so on.

Consider the difference between the work of a harvester on the prairies and a merchant in his office. The one works very hard with his muscles and comparatively little with his brain. He uses up much energy in his hard work and produces as a result much bodily waste. He requires, therefore, relatively large amounts of body-building and energy-producing foods. The merchant's brain, on

Fig. 1. Reproduced from the original by Pfandner and Schlossman.

the contrary, is intensely active; his thoughts are concentrated on many anxious problems, whereas his muscles get little exercise. Consequently, he needs less food than the harvester and of a somewhat different kind, for brain-work, however strenuous, does not wear away the body as does muscular exertion.

THREE USEFUL LESSONS MAY BE LEARNT

from a study of these specimen diets:—

(1.) The reason why our daily consumption of food is divided into meals and not eaten all at once:

- (2.) The superior attractions of varied over monotonous food:
 - (3.) The connection between the individual and the food he takes.
- Let us consider these facts more closely.

(1.) WHY WE EAT MEALS.

The body requires daily a given amount of food. Were this to be eaten all at once, the result, apart from other discomforts, would be extreme drowsiness and inactivity after eating, such as we notice in a dog after he has gorged himself, or such as is observed among uncivilized men, whose habits in this respect resemble those of certain animals. By the judicious division of his daily portion of food into three portions, eaten at different times, civilized man has found he can prolong his hours of effective work and equalize his energy.

THE NEEDS OF THE BODY ARE MET

by "stoking its furnace" with moderation at regular intervals. Its activity should be quickened, not checked, by a well-chosen meal. Where sleepiness succeeds eating, more food than is necessary has probably been taken, or food of an unsuitable character.

THE DAILY MEALS OF AN ADULT

consist, in most countries, of a fairly light breakfast and lunch, with a more substantial repast in the evening, when the day's work is over. For children, who should be early in bed, the heaviest meal must be at midday, or a store of digestive disorders will be laid up for the future, as a result of overtaking their digestive systems in the evening. Remember in this as in other connections that

YOUNG HUMAN NATURE IS VERY OBLIGING;

it will endeavour, and to all appearance succeed in the endeavour, to adapt itself to the demands so ignorantly made upon its powers. Only after the lapse of years will the result of these demands make their appearance. Errors of diet in youth are responsible for much of the disappointment in respect of health, attainments, or success in later life, of which the true cause is usually unsuspected.

ABSOLUTE REGULARITY OF INTERVAL

should be the rule for family meals; because all the workings of the body proceed in health with machine-like precision; if this be interfered with by irregularity in the hours of eating, disordered digestion and poor nutrition are bound to follow.

There are excellent reasons for this assertion. The process of digestion is a prolonged one; not only must it be completed before more food is eaten, but the

RULE OF NATURE,

that work and rest succeed each other, must also be respected. After the work of dissolving, absorbing, and circulating food material has been performed, all the organs concerned require a period of repose. If this rest is denied them their work is of poor quality and "indigestion" is the result.

A longer or shorter respite from activity is necessary for every gland concerned in the manufacture of the fluids which digest food or in the other processes of assimilation, in order to recruit energy; whether these glands are situated in the mouth, stomach, pancreas, liver, or intestines. A tired person performs poor work, so do weary organs.

(2.) THE LENGTH OF THE INTERVAL BETWEEN MEALS

depends upon the character of the food eaten at the meals. An ordinary dinner leaves the stomach in from four to five hours; whereas milk, lightly cooked eggs, stale bread, crackers, toast, or steamed or boiled white fish are digested in about half that time. The body requires an hour or two after awakening in the morning to "warm up" to its daily work; so it is a sound instinct which guides us to prefer a not too heavy breakfast.

For most people, this meal consists usually of some well-cooked cereal, coffee and milk, eggs, toast, butter, marmalade, and fruit. This is eaten somewhere between 6 and 8 a.m., and is wisely succeeded

BY A MORE SUBSTANTIAL MEAL AT NOON,

or 1 p.m., to restore energy after the morning's work. An interval of six or seven hours is none too long for an adult before supper. If this meal be the heaviest in the day, two or three hours must elapse before going to bed.

(3.) FOR YOUNG PEOPLE

such an interval as six hours would be too long; for, where an adult thrives on three meals a day and long intervals, a child and growing lad or girl require four meals in the day and shorter intervals. Why is this?

- (a.) Because a child has to add to its size as well as to repair the wear and tear of his body: i.e., he has to grow:
- (b.) Because a child lives much faster than grown persons, his bodily activities are greater; so that relatively to his weight he requires more food and that more frequently:
- (c.) Because, like all small animals, a child has a larger surface in proportion to his bulk than is the case when growth is complete, consequently he loses heat more rapidly and his furnace calls for more frequent "stokings."

A HUNGRY CHILD,

that is to say, when hunger is felt for two or three hours before it can be satisfied, is a starved child; and a starved child suffers arrest of growth and a warping of development. During the twenty-four years of active growth hunger should be thoroughly satisfied at each meal. Later in life it is wise to rise from table able to eat more.

THE SUITABLE REGULATION OF A CHILD'S MEALS

is, without doubt, a serious difficulty in most homes, where there is no "nursery" and all the household eat together, with the same length of interval. To attempt to evade the difficulty by giving "lunches" to children at odd hours between meals cannot be too strongly condemned. The subject will be dealt with in greater detail in the forthcoming bulletin on "The Care of Children."

THE ATTRACTION AND VALUE OF VARIED FOOD

was touched upon in Bulletin 36, on "The Preparation of Food"; but calls for fuller treatment than could then be devoted to it, on account of the important part it plays in good health, temperance, and happy homes.

The sense of taste is given us to be exercised in reason, just as is the sense of touch or of sight or of hearing.

Latterly this fact has assumed increased importance, as a result of the teaching of physiologists that

THE SIGHT AND ODOUR OF PLEASANT FOOD

and the act of chewing what is palatable are followed, in health, by a profuse flow of powerful gastric juice and a definite, indeed desirable, stimulus to the whole digestive system; a stimulus which is absent when food is either distasteful or flavourless. The importance, also, of neat, clean, and pretty table arrangements must not be overlooked as an aid both to good cooking and good digestion.

We must not, therefore, neglect or despise what the Germans call

"PLEASURE-GIVING THINGS"

in cookery; and the more so, in that, as a rule, they are not expensive in cash; rather they demand thought and intelligent discrimination in their employment.

All kinds of herbs come under this head; some vegetables, such as onions, shallot, garlic, carrots, celery, tomatoes, etc.; all syrups, sauces, pickles, peppers, and condiments generally. What a pleasant change is made by the addition to soup or stew,

Fig. 2. Reproduced from Bulletin No. 43, U.S. Department of Agriculture.

now of a clove of garlic, then of chopped celery or even celery salt; or of a pinch of spice instead of herbs, or by a dash of mushroom ketchup! Quite a variety of changes may be rung on what, at bottom, is composed of almost the same constituents by the intelligent use of "pleasure-giving" flavours.

The homely soup may be white to-day and brown to-morrow; rose-red with tomatoes in the autumn and winter, or pale green with fresh peas in summer; or the inevitable stew may be savoury with onions this week and more strongly suggestive of carrots at its next appearance.

The "left-overs" of a joint may be served now as a curry, then as potato-pie; on another occasion as a Cornish pasty, or, in warm weather, as a meat-loaf, dainty with decoration of hard-boiled egg and salad.

Potatoes can be boiled or baked in their jackets; or peeled and browned with the roasting joint; or mashed, or sliced, tossed in dripping or lard and baked in a fireproof dish in the oven; or they can be "riced" through a colander, or served cold in cubes, covered with white sauce well flavoured with onions.

Rice can be steamed and served with curry, sugar, or syrup; or boiled with milk and "moulded" to eat with stewed fruit. It can be cooked with stock and the ever-useful celery or onion, or baked with grated cheese moistened with milk, dripping, or batter.

Remainders of bread can be crisped in the oven to eat with butter, cheese, or soup; they can be cut in thin slices to make bread and butter or bread and jam pudding; or into finger-strips to line a pudding-basin, filled with stewed fruit and eaten with cream or custard. They can be grated into crumbs to make apple charlotte or steamed or baked lemon-puddings. If bread-crumbs are mixed with milk in which an onion and some cloves have been boiled, the delicious bread-sauce which results will transform somewhat tasteless veal into an appetizing repast and lend a new flavour to whitefish.

Well-browned bread-crumbs, mixed with tomatoes or carrots or fish, eggs, cheese, or mashed potato (these last five combinations call for some white sauce, stock, or milk for moistening), make most delicious scallops, especially attractive when served in fireproof dishes, in which they can be cooked, by the way, at very little cost of time or trouble.

Tapioca and sago, also, useful and easily digested forms of carbohydrate food, need not be monotonously presented as "milk-puddings." Set a cupful of either grain to soak for twenty-four hours in cold water, then mix with some juicy fruit or syrup or tomatoes or well-flavoured soup, and cook several hours in a double boiler. The result will be a firm jelly which, when moulded, cooled, and served, will be a most popular "dessert" or addition to a cold-meat meal in summer-time, when the advantage over the use of gelatine will be readily observed, for sago or tapioca jelly "sets" at any temperature. Cream or custard should accompany this "dessert"; while the addition of a few cold peas or beans, or chopped egg or carrot, or "remainders" of ham or fish or chicken to the "stock" jelly will enable a considerable variety of flavours to be provided.

Cheese can be grated and cooked in an almost infinite variety of forms, and can be rendered easily digestible to most, if not all, consumers by the addition of a very small quantity of powdered bicarbonate of potash, in the proportion of $\frac{1}{4}$ oz. to 1 lb. of cheese, or say a large pinch to $\frac{1}{4}$ lb. of cheese. The potash should be dissolved in a little milk or water before being added to the cheese. Its effect is to restore to its original soluble form the indigestible substance in cheese (casein), the form, that is to say, in which it exists in milk. This result is seen in the soft, creamy consistency of the cooked cheese.

A SAVOURY AND HIGHLY NUTRITIOUS DISH

is the result of mixing together two parts of grated bread-crumbs to one part of grated cheese, and pouring over the mixture a batter of eggs and milk, in which the potash has been dissolved and to which a seasoning of pepper, salt, and mustard has been added. This should be baked in a shallow, well-greased tin and eaten with crisped bread as a substitute for, not supplement to, a meat dish. The mistake of combining meat with cheese at one meal lies at the root of much of the reputed indigestibility of cheese, for both are highly concentrated forms of body-building foods.

Grated cheese may be stirred into oatmeal porridge or mixed with the floury contents of baked potatoes; even hasty puddings may be converted into a savoury dish by the addition of a little grated cheese.

Fish-pudding (made by mixing the remains of any cold, cooked whitefish with bread-crumbs, grated cheese, and ketchup), vegetable marrows stuffed with a similar mixture, turnips served with white sauce into which cheese has been stirred, are but a few suggestions how to provide "pleasure-giving" and wholesome food at small cost of time or money—only never omit to add the dissolved bicarbonate of potash.

Fig. 3. Reproduced by kind permission of E. J. Arnold, Leeds, England.

Fat is always an essential of wholesome meals; it exercises a definite influence on digestion, and is an agent in the prevention of that prevalent trouble—constipation—besides being a source of fuel reserve to the body. How to provide it in a pleasurable form is not always easy, especially where the supply of milk and cream or butter is restricted. It so often happens that the fat of meat is disliked; and distasteful food is ill-digested.

During the winter, in particular, a liberal supply of fat in the diet is important to health; fortunately it is just at this colder season of the year that conditions are favourable to a form of fat in food which is rarely disliked—namely, puddings, in the compounding of which lard, suet, or dripping play a part.

THE VARIETY OF THESE PUDDINGS

and their method of service is well-nigh limitless. They may appear as raisin, ginger, lemon, or fruit puddings; they may be served with sauces, sweet or savoury; they may form a crust enclosing meat, game, or fruit; they may be boiled, steamed, or baked, preferably steamed, and the longer, in reason, the steaming process, the more successful and digestible the pudding. The fireless cooker is a valuable ally in the preparation of such puddings, which are acceptable to most people until the weather becomes mild, when they quickly cease to be "pleasure-giving." Then follows the season for "lighter desserts," in which eggs, cream, and milk enter more prominently, when, happily, they are at their cheapest.

Fig. 4 clearly demonstrates the high worth of an egg as a source of fat in our diet; and fat, too, in a highly digestible form. Butter and cream also furnish this nutrient in a much more easily assimilated form than the fat of beef or mutton, for instance, which tax some digestions, especially when eaten cold. This remark does not apply to finely grated suet or to "well-rubbed-in" lard, which rarely disagree when sufficiently cooked in pudding form after the age of two or three years.

Doubtless, the question of the position of pastry and cakes as

"PLEASURE-GIVING" ELEMENTS IN OUR DIET

has been already asked mentally by every reader of these pages. "*Is* pastry wholesome; and, if not, why not?" will be on the lips of every consumer of the popular national dish—*pie*.

Well-made, well-baked pastry is a quite allowable "pleasure" to healthy adults, if eaten with moderation and not too frequently. It should certainly not enter into the dietary of children, for good reasons.

As was explained on page 11 in Bulletin 36, all the nutrients in starch foods are enclosed in indigestible envelopes which it is the object of cooking to burst or dissolve. Now, when butter or any form of fat is combined with flour and then baked, each grain of starch is enclosed in a film of grease. Grease, as we all know, protects what it covers from moisture; consequently, the water with which the pastry is mixed cannot reach the particles of fat-coated flour, and they remain largely unchanged in character—that is to say, indigestible.

A CHILD NEEDS TO UTILIZE EVERY SCRAP OF FOOD EATEN

if he is to grow and thrive; but his digestive system is not fully developed, and is liable to suffer more or less seriously from efforts to grapple with material unsuited to its capacity. Good pastry, once or twice a week, therefore, is legitimate for the average adult, but illegitimate for the child.

Another reason for the "bad name" given to pastry lies in the change undergone by fat when exposed to the high temperature necessary to the baking of successful pastry. Irritating products are formed which interfere with the process of normal digestion.

IN RESPECT OF CAKES,

so much depends on the conditions under which they are eaten and the kind of cake. A slice or two of plain cake, eaten at meal-time, is allowable for all ages after the second or third year. It is a medium for fat and carbohydrates, susceptible of a wide variety in flavour, even when quite inexpensive ingredients are employed. But if rich with butter, eggs, nuts, and fruit, then the matter assumes a different complexion; for the compound is highly concentrated and nutritious, only to be eaten very sparingly even by adults, on account of the tax it imposes on the digestion. Such cakes are wholly objectionable for children.

THE CUSTOM OF ADDING CHOPPED NUTS TO CAKES

increases to a very high degree their digestive demands; they become undesirable as additions to a full meal; while currants, whether fresh or dried, can never be digested, and often cause considerable intestinal irritation in young children. Raisins and sultanas should always replace currants in the interests of health.

A WIDE RANGE OF PLAIN CAKES

can be made with few eggs or none, with dripping or lard instead of butter, flavoured with ginger and molasses, or with mixed spices, or with lemon or cocoa, which are quite attractive and wholesome also.

MUSTARD, PEPPER, SALT, VINEGAR, CAPERS, HORSE-RADISH, RED-CURRANT JELLY, APPLE-SAUCE, AND LAST, BUT NOT LEAST, SUGAR

are permissible *condiments* at meals, *if* the rule of moderate consumption be strictly observed, and *if* their use be confined (except in the case of sugar and salt) to those over fourteen or fifteen years of age. They all stimulate the flow of the digestive juices, hence the custom of eating mustard with rich meats, such as beef or pork, goose or duck; pepper, too, is habitually taken with green vegetables and vinegar with raw salads; because, unconsciously, the eater is aware that these foods call for energetic digestion.

Capers lend flavour to otherwise somewhat tasteless boiled or steamed mutton; apple-sauce seems to counteract the excess of fat in pork or goose; and red-currant jelly supplies the carbohydrate in which mutton or venison are deficient.

Vinegar has an important action in softening the fibres of tough meat or of crab or lobster or of green vegetables, but its continuous or excessive use is inadvisable; consequently, pickles must not be condiments of daily consumption.

SPICES AND CERTAIN HERBS

such as fennel, or seeds such as caraways, also relieve the flatulence and associated distressing distension experienced in some forms of dyspepsia, besides imparting variety of flavour to food. Their employment for many generations in these capacities offers another illustration of the sound instinct by which uncivilized man was guided in the choice of his sustenance.

NONE OF THESE CONDIMENTS EXCEPT SUGAR HAVE ACTUAL FOOD-VALUE,

but used with discretion they contribute to the digestion and assimilation of the foods to which they are added.

The use of sugar as a "pleasure-giving" agent needs little recommendation; rather

A CAUTION MAY HAVE TO BE UTTERED

as to the amount consumed and the form in which it is taken. There is no question as to its importance as an article of diet; but what the public fail to appreciate is that several different varieties of sugar enter into the composition of the forms which appear at our tables, of which some are more wholesome than others. Cane, beet, maple, and milk sugar all belong to one large class; of the other, grape-sugar (familiar to us in raisins) and honey are examples. This class is the more digestible of the two; as a matter of fact, all the sugars which belong to the first class must be changed into the form which distinguishes those grouped in the second class before they can be utilized by the body; hence these are a stage nearer digestion.

THIS CHANGE MAY BE BROUGHT ABOUT

by the digestive organs or by heat and acids, of which the alteration effected in the cane-sugar used in jam-making offers an excellent illustration. For this reason, honey is often better digested than golden syrup or molasses, which are products of cane-sugar.

CANDIES

are made from both classes of sugar; sugar-candy and barley-sugar, for instance, or toffee are made from cane-sugar, while caramels and the creamy matter in chocolate-creams are made with an imitation of the sugar found in grapes. This is now

manufactured on a large scale and is described as "commercial glucose." It is usually produced by boiling starch with acids, and is quite wholesome when properly prepared. In these days there is little cause

TO SUSPECT THE NATURE OF THE COLOURING MATTER EMPLOYED

to render candies attractive. The risk associated with their consumption lies rather in the temptation they offer to eat sugar to excess and in too concentrated a form, when it is liable to exercise a seriously irritant effect on the stomach, interfering with the digestion of other foods besides itself.

TO AVOID THESE RISKS

it is wise to imitate the comparative dilution in which sugar occurs in natural foods, such as milk and fresh fruit. A healthy adult can eat the equivalent of a quarter of a pound of cane-sugar a day with advantage; but this amount should be distributed over his three meals and should appear in varied forms. If called upon for sudden and severe muscular exertion, the addition of another ounce to the day's allowance will be found directly beneficial, as it is a rapidly absorbed source of energy.

THE WORTH OF SUITABLE FRUIT

as a medium for sugar for adults and children must again be emphasized, on account of its digestibility when so taken; and *an urgent appeal* is made to all readers and their children to restrict or to reduce to vanishing point the deplorable extravagance involved in a constant consumption of candies.

THIS APPEAL IS A REALLY EARNEST AND URGENT ONE:

(1.) Because, almost without exception, candies present sugar in an unwholesomely concentrated form, inevitably damaging and irritating.

(2.) Because they breed dyspepsia and other ailments, the result of being "sucked" at odd hours, and thus overtaxing the digestive organs by depriving them of their necessary rest; with the effect of promoting poor nutrition and ill-health.

(3.) Because they interfere with wholesome and natural appetite for simple food at regular intervals and cultivate a taste for highly flavoured fare, which often leads to a whole train of unsuspected mischief, of which one form assumes that of

INTEMPERANCE IN RESPECT OF ALCOHOL.

One reason for habitual recourse to alcohol exists undoubtedly in the apparent fillip which it gives to a jaded palate and the relief temporarily experienced from the discomforts associated with digestive disorders. The explanation of these is found in the fact that one of the first results of alcohol is to numb certain sensations, which give rise to the false and dangerous misapprehension that it has cured them

WHEN THE HABIT OF EATING CANDIES AT ALL HOURS

is established during childhood, healthy appetite wanes, nutrition suffers, and the palate craves for more and more powerful stimulants. With youth comes greater liberty of action and increased temptation to resort to any means which will give an appearance of being lively, attractive, or manly. Alcohol in some form or another seems to offer just the desired spur. The tired, unhealthy stomach is whipped into a spurt of activity, the depression of dyspepsia is temporarily dispersed by the false excitement which follows a glass of spirits, and the wits appear to be brightened; a sharpness which to those who know the true working of alcohol in the body, simply means that the usual power of self-control is numbed and the ordinary and desirable reserve of speech and gesture is relaxed.

IT WAS OF DELIBERATE INTENTION THAT TEMPERANCE WAS ENUMERATED

among the advantageous results of providing intelligently varied food on the family table. Many a lad and girl slip down the slide of intemperance from no other cause

than the deadly monotony of their diet, which produces an overmastering craving for some change of flavour and some stimulus to their unexercised sense of taste.

A wholesome variety in food is only one factor in temperance, but it is a very important one, therefore it has been dealt with at some length.

Before proceeding to a consideration of the connection between an individual and the food which suits him, it will be helpful to pass in review some

GENERAL CONSIDERATIONS WHICH AFFECT OUR DIET.

The fact that no specimen diet can be rigidly adhered to in any particular family will become clear after a study of this section. Not that the publication or perusal of such dietary tables is therefore to be condemned or despised as waste of time; they are useful to the housewife in several connections, as well as to the scientist. If the constituents and amount of the usual food of a large range of individuals be compared, individuals living in different countries and under different conditions, it will be observed that, on the whole, the results conform quite closely to the ideal standard which has been laid down as to the character, cost, and quantity of food to be eaten. Of course,

AMONG THE VERY POOR

the daily meals would be insufficient in quantity to maintain health, while among the well-to-do the diet would err on the side of excess; but, as a whole, healthy people select their food with considerable intelligence; that is to say, *if they get the chance and if they have been wisely trained in childhood*. Both the chance and the training depend upon our house-mothers.

The use of printed diet tables becomes apparent if a member of the family flag, lose appetite, or develop an abnormal capacity for food. It is very helpful to turn to some guide as to just about what amount and kind of food is natural at that age and under those conditions of life; so that, unknown to the individual, means to correct these abnormalities may be found. Girls about fifteen, for instance, often take up quaint and unwholesome food fads which cannot be sanctioned; as, for example, when they desire to sustain life upon a diet of cucumber and tea!

Anæmia is a far too common complaint in early life. If a case occur in the house, how useful is the knowledge that eggs are a particularly valuable food for anæmic people, especially when combined with spinach, because in both cases iron is present in a very assimilable form.

MANY CHILDREN, IN THESE DAYS, OFTEN TAKE A DISLIKE TO MILK;

but, if the housekeeper is aware that until thirteen or fourteen years of age a quart of milk a day should enter into the diet and is alive to this necessity, ingenuity will be exercised in the concoction of dishes which contain the requisite amount of milk unknown to the consumer. Junket, for instance, or milk-soups, plain custards, cornstarch or rice and other moulds, variously flavoured simple white sauces to eat with vegetables, or bread-sauce with meat, poultry, game, or fish. The great value of skim-milk as a body-building food is not half appreciated; it is cheap, excellent, and nutritious. Finally, these diet tables are invaluable

WHEN RESPONSIBILITY IS ASSUMED FOR THE CARE

of institutions and their inmates. They guide the judgment as to the probable sufficiency of the food supplied to those who have no control in the matter of their own diet.

Assistance will also be derived from a study of the diagrams with which this bulletin is illustrated, where the proportions of nutrients present have been purposely associated with familiar forms of food, so that each time these are in use they will serve to remind the cook of their relative nutritive value.

FIG. 4 IMPRESSES TWO VALUABLE FACTS:

(1.) That milk alone is an insufficient food after early infancy; and that it is a useful, though not cheap, source of protein and fat at all ages, when combined with other nutrients. Skim-milk, on the contrary, is the cheapest source of animal food we have.

(2.) That in considering the food-value of an egg, it must be borne in mind that about one-third of this value is protein and two-thirds fat; and fat of a most digestible form.

FIG. 3 ILLUSTRATES THE CONCENTRATION OF PROTEIN AND FAT IN CHEESE,
about three-fourths of its food-value being fat. Thus cheese is a very cheap food when properly prepared. This diagram demonstrates also the relatively

PROXIMATE PRINCIPLES OF FOODS.

BODY-BUILDING and FLESH-FORMING.

- A. Water
- B. Proteids
- C. Mineral matter
- D. Fat
- E. Starches & Sugars (Carbohydrates)

HEAT and ENERGY-GIVING.

- A. Water
- B. Proteids
- C. Mineral matter
- D. Fat

Fig. 4. Reproduced by kind permission of E. J. Arnold, Leeds, England.

high food-value of a herring. It is a perfectly sound instinct which leads the very poor to buy a "kipper" as a relish to their dry bread, but it is an unsound custom which serves herring or salmon (another fat fish) before a meat course at dinner, especially if the meat be itself rich in fat, say beef or pork. If poultry or game follow such fish this objection is removed, for, in their case, there is usually a deficiency of fat. For the same reason

THESE FISH ARE UNSUITED FOR THE DIET OF YOUNG CHILDREN.

Dried and smoked fish are some of the cheapest sources of protein for their elders, because they sell for about the same price per pound as fresh fish, but contain less than half the amount of water.

FIG. 1 SHOWS THE PROPORTION OF NUTRIENTS IN A TYPICAL CUT OF MEAT AND IN A LOAF OF BREAD.

The worth of the latter as our main source of carbohydrate food is well brought out. Most people will probably be surprised at the amount of "gas" present in a well-made loaf; it certainly constitutes a good reason why indigestion is associated with heavy, "soggy" bread.

Bread is, in fact, one of the most nutritious among our daily foods, but it cannot be regarded as a perfect food, for it contains about eight and one-half parts of carbohydrates to one part of protein; whereas the right relation of these nutrients is as 1: 4.2; neither does it contain more than a trace of fat.

The opinion of experts differs as to the actual

WORTH OF HOME BAKING.

In any case, the saving is rather in the cash cost than in enhanced food-value. If the fuel used and the worker's time are added to the price of the flour, little saving is effected; and the time could be better employed (where baker's bread is available) in adding to the variety of the family diet.

BREAD WILL KEEP QUITE WHOLESOME FOR A WEEK

or more if stored under good conditions; so that an ample supply can be bought at weekly intervals without risk of waste. No doubt one reason for the faith in home-made bread lies in the popular idea that it is far more nutritious, because it is believed that

FLOUR OF A MORE NUTRITIOUS QUALITY

is employed, and that the conditions of its preparation are superior. There is considerable strength in this latter argument; for,

UNLESS A CAREFUL LICENSING OF BAKE-HOUSES BE ENFORCED

and a system of constant inspection be insisted upon, the conditions in bake-houses are too often insanitary, even shocking and disgusting.

THE FOLLOWING QUOTATIONS,

taken from Dr. J. M. Hamill's report to the Imperial Government on "The Nutritive Value of Bread" made from different varieties of wheat-flour, will be welcomed by many who are perplexed by the rival claims of different brands of flour. The date of this report is 1911.

"THE DIFFERENCES IN NATURE AND NUTRITIVE VALUE

between breads made from different classes of flour . . . do not appear to be of much importance to the average adult, with whom bread is only one out of many varied constituents of his dietary. The notion, for example, that ordinary high-grade and naturally white 'patent' flour is practically devoid of protein or nitrogenous constituents, whereas the latter are abundantly present in bread made from whole-meal and 'entire' wheat-flours, is erroneous. The differences which exist in this respect are not relatively of great magnitude, and they may, to a large extent, be neutralized by imperfect absorption from the digestive tract.

. . . In other words,

**"A 'PATENT' FLOUR OBTAINED FROM ONE VARIETY OF WHEAT MAY
CONTAIN CONSIDERABLY MORE TOTAL PROTEIN**

and furnish more available energy than an 'entire' wheat or whole-meal flour from another kind of wheat. . . . Relatively marked differences exist between different classes of flour even when derived from the same wheat. . . . To the average adult

however, these differences cannot ordinarily be of importance. . . . If now the question be asked what variety of flour is best suited for the diet of those adults whose food consists principally of bread, it should in the first place be answered that a diet which consists principally of bread, from whatever grade of flour it may be made, is unsatisfactory, and that it is more important for those who for one reason or another are in this position to secure a greater variety of diet—which does not always mean greater cost—than to rely upon the selection of any particular form of bread, however nutritious. . . . It is asserted that whole-meal bread and to a less extent bread made from flours of the 'entire' wheat class are not so liable to aid the production of caries of the teeth, as a result of fermentative changes, as is bread made from a highly refined flour such as patent grade flour. The evidence on this point, however, cannot be considered conclusive in the absence of more exact experiment."

PROXIMATE PRINCIPLES OF FOODS.

Body-building and Flesh-forming.

Heat and Energy-giving.

Fig. 5. Reproduced by kind permission of E. J. Arnold, Leeds, England.

FIG. 5 OPENS UP THE IMPORTANT QUESTION OF THE PLACE ON OUR TABLES OF FRUIT AND VEGETABLES.

It is wise to remember, and to let the remembrance influence practice, that all fruits require digestion; though the common habit of eating raw fruit at odd hours throughout the day shows public ignorance of or indifference to this fact.

Fruit is eaten with most benefit at breakfast, when its worth as an agent in promoting the regular action of the bowels is well recognized. "An apple a day keeps the doctor away" is a wise old "saw."

EVERY KIND OF RIPE FRUIT IS PERMISSIBLE TO THE HEALTHY ADULT

if peeled and cored; to eat peel is foolish, if not criminal; it is about as digestible as cork, and may be the carrier of serious infection owing to the questionably clean hands through which it often passes and the unsatisfactory conditions under which it may be stored. Stewed or baked fruit is always more easily digested than when raw.

IN THE CASE OF YOUNG CHILDREN AND DELICATE ADULTS,

currants, gooseberries, figs, and rhubarb are unsuitable. The skins and seeds of the berries and figs and the stringy structure of rhubarb constitute serious irritants to the intestines and cause many digestive troubles. The pips and skins of grapes can be removed, but those of berries and figs are too small to be handled.

A CAUTION MUST BE GIVEN ON THE SUBJECT OF BANANAS,

which are a highly nutritious fruit, as the diagram shows. They ought only to be eaten as a part of a meal, and must be entirely forbidden to young children unless baked; for the starch they contain is so combined with cellulose as to be quite unfit for immature digestive organs.

If fruit has to be bought,

DRIED FRUIT IS ACTUALLY CHEAPER THAN FRESH,

because the large content of water has been evaporated; when well soaked and properly cooked they supply a useful element in winter diet.

NUTS HAVE A HIGH FOOD-VALUE;

indeed, they are a specially concentrated form of food, so must be employed with discretion, not casually eaten by the handful or mixed vaguely into cakes or combined with desserts, as if they were no more than flavouring essences. A slice of nut-bread represents the equivalent of a meat-sandwich, only in a less easily digestible form. When ground or crushed or well masticated, nuts add a pleasant item to our dietary; but they should be looked upon as a partial substitute for meat, not as a condiment.

POTATOES ARE USED SO FREELY IN EVERY HOUSEHOLD

that this diagram of their worth as food is sure to arouse interest. They have about a quarter the nutritive value of bread, but offer a useful form of carbohydrate, in addition to their importance as a source of mineral salts. The waste of nutrients in carelessly peeled potatoes is also depicted; for reckless waste is always sinful, whatever the income may be.

IN FIG. 2 IS SHOWN THE CONSTITUENTS OF CARROTS AND CABBAGE,

which with turnips, onions, squash, and other winter vegetables provide flavourings, salts, and bulk in our diet. They thus contribute to its nutritious qualities by promoting digestion, assimilation, and excretion.

WHAT ARE WE TO BELIEVE ABOUT THE FOOD-VALUE OF PEAS, BEANS, AND LENTILS?

will be the next question. Can these pulses replace meat, and is vegetarianism really advisable for us all?

The nutritive value of pulses is high, especially in protein; indeed, a kind of cheese and even an artificial milk can be prepared from soy beans; but all pulses require many hours' soaking as well as prolonged cooking before they are eatable, which is not always convenient or economical of fuel. By the way, the addition of a small amount of bicarbonate of potash to the water in which they are soaked renders them more digestible. During the soaking process

THERE IS AN INEVITABLE LOSS OF NUTRIENT MATERIAL,

and the proportion of water rises—in haricot beans, for instance, from 14 to 73 per cent., and in peas from 9.7 up to 86.9 per cent. This means, of course, a corresponding increase in bulk.

A world-wide authority on the subject of food, Dr. Robert Hutchison, says that

TWENTY-FOUR PLATEFULS OF THICK PEA-SOUP

would be required to give an average man his day's supply of protein; and even then he would have too little carbohydrate and fat; though were the soup made with milk instead of water, eight platefuls would suffice. Such a bulk of food is ill-adapted to the human stomach, of which the utmost capacity is three pints.

THE OLD GREEK PHYSICIAN, GALEN (A.D. 130-180),

was quite right when he said, "Pulses are harder to digest than other foods and give bad dreams." They are, however, useful to eat with bacon, pork, or other fatty foods in winter-time, especially for those who lead an active life; but if eaten frequently by those who lead sedentary lives they are liable to cause flatulence and other digestive troubles.

ONE OBJECTION TO VEGETARIAN DIET LIES IN THIS MATTER OF BULK.

The volume and structure of a cow's stomach illustrates the provision made by nature for the accommodation and digestion of the masses of foodstuff required by an animal dependent for its sustenance on vegetable substances only.

THE STRUCTURE OF THE TEETH AND DIGESTIVE TRACT

in the human body afford evidence that man is designed for the mixed diet he usually prefers when in health. The fact that he has drifted into an excessive reliance on animal food does not call for a violent reaction in favour of a purely vegetable diet. In this, as in other matters which affect our health,

IT IS THE HAPPY MEAN FOR WHICH WE SHOULD STRIVE.

The place of *cereals* in our bill of fare must be treated with great brevity owing to the limitations of space. From the nutritive standpoint oatmeal heads the list; it is so rich in protein, fat, carbohydrates, and salts. But, unfortunately, the husk is so closely adherent to the kernel that it cannot be separated by ordinary grinding. The small sharp particles which remain lend to

OATMEAL ITS QUALITY AS A CORRECTIVE

of constipation, on account of their irritating effect on sluggish intestines. This irritation may, however, be detrimental to the delicate lining of the bowels, which has led some physicians to forbid the use of oatmeal for children. The exact reason for the "heating" effect it has in some cases is not yet known. The numerous

PATENT PREPARATIONS OF BREAKFAST FOODS

on the market possess at least two advantages over ordinary oatmeal. The treatment through which they are passed ruptures the tough cellulose walls of the grains and partially cooks the nutrients within. Time is thus economized in their domestic preparation and they become much more digestible; but the price asked in some cases is wholly out of proportion to the food-value of the much-advertised goods. Of course, to some people it is worth paying dearly for the convenience, variety, palatability, and cleanliness of these patent preparations.

MACARONI, SEMOLINA, AND VERMICELLI

contain more than twice the protein present in *rice*, and are useful, cheap foods, especially when cooked with eggs, cheese, or minced meat. Rice is the poorest of

all cereals in protein, fat, and salts; it is also only moderately easy of digestion, so that it is a dangerous delusion which accepts rice as a staple article of diet in this climate. At least

FIVE POUNDS OF COOKED RICE

would have to be eaten daily by an active man to supply his need for carbohydrates; meanwhile he would be starved in respect of protein and fat. Such food fads as this are very risky, especially if they are allowed to affect the diet of young folk.

THE QUESTION OF BEVERAGES

must also receive attention in these "general considerations," for upon them depend much of our health and comfort.

Water is the natural beverage for human beings, as it is for most animals. There is no foundation for the current opinion that free drinking of water with meals hampers digestion, by diluting the gastric juice. One pint of water at a meal has no such effect, probably treble that amount would be needed to be detrimental

HOT WATER IS A VALUABLE BEVERAGE,

if for no other reason than that, as it passes rapidly through the stomach, its warmth increases advantageously the movement of the stomach-walls and thus conduces to efficient digestion; it is also beneficial because it raises the temperature of the cold food with which it mixes. All food must reach a temperature of at least 100° Fahr. before the process of digestion can proceed. Cold water as well as hot softens the food received into the stomach, assisting it to dissolve.

WATER IS AN INDISPENSABLE AGENT IN EXCRETION,

for it passes rapidly into the intestines, is readily absorbed, and by increasing the fulness of the blood-vessels promotes intestinal movement and secretion. Large quantities of water passing through the intestines cleanses them also, and thus reduces a tendency to intestinal fermentation.

HENCE, RESTRICTION IN THE AMOUNT OF WATER DRUNK

means a whole train of miseries, such as gout, because waste matters are liable to "loiter" in the tissues instead of being thoroughly washed out of them.

"SOFT DRINKS"

have certain definite dietetic advantages. They consist of natural or artificially prepared water highly charged with carbonic-acid gas, with the addition of soda, potash, ginger, sugar, or flavouring matters. The gas is an aid to digestion. Chemically, it promotes an abundant secretion of gastric juice; mechanically, the bubbling-up of the gas through the contents of the stomach helps to break them up into particles, so that larger and more numerous surfaces come in contact with the digestive juice.

Lemonade, orangeade, etc., contain about 1 oz. of sugar per bottle, which may explain their refreshing influence on cyclists or athletes when fatigued; but with some people they disagree, a result which may be due to the amount of sugar present, or to the employment of mineral instead of vegetable acid in their manufacture, the effects of which on the body are directly opposed.

TEA AND COFFEE ARE PLEASANT BEVERAGES,

and quite legitimate if made and drunk under correct conditions. In health they exercise no disturbing influence; indeed, they are great aids to mental work and "oil the wheels of life" by their gentle stimulation of the brain and nervous system.

WHAT, THEN, ARE THE CORRECT CONDITIONS TO BE OBSERVED?

(1.) Tea should be infused not more than five minutes in freshly boiling water; then the liquid should be poured off into another hot vessel. Coffee should be similarly prepared in a jug or percolator, so that the water does not remain in contact with the "grounds."

(2.) The addition of milk or cream is recommended, for the albuminous matter in milk throws down the tannic acid present in an insoluble form. For this reason, if tea has stood too long and become "strong," it is made more wholesome by the addition of milk rather than of water. Three parts of hot milk to one part of coffee is the breakfast beverage common to the greater part of Europe. It is to be commended as both useful and nutritive, adapted to morning requirements.

(3.) Sugar adds to the nutritive value of these beverages, but probably detracts from their healthfulness.

(4.) Both tea and coffee should be avoided at meat meals, especially tea. Members of the Women's Institutes will be doing a valuable bit of work if they unite in a determination to banish tea from their tables at dinner and supper. In the first place,

TEA AND COFFEE ARE CERTAINLY HINDRANCES TO DIGESTION

when drunk at these meals. In the second place, a small cup of either beverage is an insufficient amount of fluid for adults. At least three-quarters of a pint of water is necessary; a pint will, in most cases, be still more beneficial. In the third place, tea and coffee are not substitutes for water in their effect on the body.

(5.) When the breakfast is a light one, either tea or coffee may be drunk by adults with advantage, and again midway between meals in the afternoon; a British custom which is worthy of adoption on this continent.

(6.) THESE BEVERAGES SHOULD BE USED SPARINGLY

by "nervous" people, and not at all by children, whose nervous systems are peculiarly susceptible to their possibly unsatisfactory effects on nerves and digestion. Personal peculiarities play a great part in the effect of either drink on adults even in health and can never be neglected.

COCOA OCCUPIES A PLACE

not really very different from tea and coffee. Its action as a stimulant is less, but the popular idea of its nutritive value has small foundation, because so little of it can be taken at a time. It is the milk and sugar mixed with it, not the cocoa, which constitute it a "food." To supply the energy for an ordinary day's work it would be necessary to consume 15 oz. of cocoa, made into seventy-five cupfuls, an impossible undertaking. Cocoa must therefore be looked upon more as a flavouring matter than as a food. Like toast, apple, lemon, etc., it

SERVES TO MAKE A PLEASANT VARIETY IN OUR BEVERAGES,

and often enables a faddist to be induced to drink a desirable amount of milk which would be refused as indigestible if unflavoured with cocoa.

ALCOHOL IN ANY FORM SHOULD BE BANISHED FROM THE TABLE,

no matter how "festive" the occasion, for the following among many more substantial reasons:—

(1.) The results of carefully conducted and unprejudiced investigations show that it is unfavourable to muscular work and is a direct hindrance to mental exertion.

(2.) The medical profession is now convinced that alcohol is unnecessary to any person in ordinary health; though some form of spirit is advisedly kept in the house, under lock and key, for use in emergency, such as acute illness or profound exhaustion.

(3.) Alcohol leads to a rapid loss of heat from the body, because its first effect is to drive all the blood to the surface. As our sensations are located in the skin, the result is the feeling of pleasing warmth which gives rise to the misapprehension that stimulants "warm," whereas most drunkards die of cold if exposed to wet or severe weather when intoxicated.

TO TAKE ALCOHOL BEFORE GOING OUT INTO THE COLD

enhances all the risks from chill. On the other hand, a small dose of alcohol in hot water *after* unusual exposure is sometimes beneficial, because its effect is to drive back to the surface the blood which has been withdrawn to the deeper parts of the body in order to maintain the body-temperature, and thus to lessen the tendency to congestion of the internal organs.

(4.) FOR SOME REASON, NOT YET ENTIRELY EXPLAINED,

the effects of alcohol on human beings to-day, and through them upon their offspring, appear to be more pernicious than was formerly the case. Therefore, in the interests of national health and Imperial stability, complete abstinence from alcohol is demanded on the part of those who are not even tempted to take it to excess.

MORE DETRIMENTAL THAN OCCASIONAL INTOXICATION

is the habitual taking of "nips," which play grievous havoc with the tissues, especially those of the brain, and result in a gradual deterioration throughout the whole body. But this is a huge subject, impossible of detailed treatment in this bulletin, the remainder of which must be devoted to a consideration of

THE CONNECTION BETWEEN THE INDIVIDUAL AND HIS FOOD.

Readers of this section are particularly requested to bear in mind that the remarks made apply to the healthy adult, not to children or invalids.

(1.) HOW THE TIME OF DAY AFFECTS THE FOOD EATEN.

So many incidental allusions have been made to this factor in a suitable diet that little need be added to them. A fairly light breakfast, the heaviest meal of the day about 6 or 7 p.m., a midday repast more or less substantial according to occupation, age, and season, a very light supper, if for any reason dinner at 7 is impossible; these are good general rules for our guidance.

TO BE HUNGRY IS FAR MORE WHOLESOME

than to eat so often and so heavily that the next meal is offered before there is a natural appetite to eat it. The stomach is not ready for a rich, heavy breakfast, unless some hours of work are carried on before the meal; and indigestion is being courted if a heavy repast be taken just before the bed hour, especially if very tired.

(2.) THE SEASON OF THE YEAR AND ITS INFLUENCE UPON FOOD.

A healthy instinct is generally a safe guide in this matter if we have any choice in the selection of dishes. Thick soups, pork and beans, stews and suet puddings, all appeal to our appetite in cold weather; root vegetables and onions are enjoyed, and cooked cheese in its many forms is acceptable.

With the first warm days of spring, not only is less food eaten, but a longing for salads and lighter "desserts" is experienced. Stews become distasteful and must be replaced by curried or hashed or minced meat. Milk-puddings and stewed fruit commend themselves,

WHILE THE SKILFUL COMBINATION

of apples with rhubarb or cranberries or blackberries supply a sharpness and fresh flavour which is most appreciated. It is just in the spring that new receipts will appeal to the family; they should always be on hand for this season.

Clear soups and purées of fresh vegetables are liked even in summer, when

ALL KINDS OF CHANGES HAVE TO BE RUNG

on cornstarch, ground rice, tapioca, and other "moulds" made with milk or fruit-juice. Eggs can be prepared in a large variety of forms and can be cooked with tomatoes, spinach, and other vegetables. Fresh peas and beans can be served, hot or cold, with ham or bacon, while salmon, chicken, or veal can be prepared in many different ways. The consumption of meat is wisely reduced in hot weather.

FRUIT SHOULD ENTER PROMINENTLY INTO THE DIET,

and cakes and puddings should be less rich in eggs and butter than in cold weather. Salads are most appetizing; though their digestibility is further hampered when they are smothered in rich dressings. Autumn brings the welcome variety of game and venison, many favourite fruits, and appetites sharpened by cooler weather.

IT IS WELL TO BEAR IN MIND AT ALL SEASONS

that to force excess of food on the reluctant consumer does not make for health, neither does it constitute true hospitality. Always make it easy for any member of the family, as well as the casual visitor, to decline food or to diminish the ordinary quantity without attracting attention.

(3.) THE AGE AND STATE OF HEALTH OF THE EATER.

It has already been pointed out (in Part I.) that the proportions of nutrients required throughout life vary with the age of the eater. After middle life less and less food is needed, because the bodily activities diminish and the power of the tissues to assimilate nourishment becomes smaller.

"THE DANGER OF OVERFEEDING THE OLD

is almost as great as that of underfeeding the young," writes Dr. R. Hutchison; "an excess of nourishment chokes instead of feeding the flickering flame of life." A most useful guide to this variation in food requirements is furnished in Fig. 1, Part I., of this Bulletin. It is not suggested that the actual number of ounces of each nutrient (as represented by these curves) should be calculated for each year of age; but the relative requirements are clearly indicated, and that is what the housewife wants.

THE ACTUAL AMOUNT OF FOOD NEEDED

at the same age varies with each one of us. Women eat less than men, though perhaps of equal height and weight. It is generally accepted that, other things being equal, a woman would eat but eight parts of food where a man would eat ten parts.

THE BUILD AND SHAPE OF THE BODY

influence the consumption of food more than is suspected, i.e., the amount of food required resolves itself into a question of surface. The larger the surface relative to the bulk of the body, the greater the loss of heat and the greater the amount of food needed to maintain the normal temperature. Picture for a moment a very tall, lean man and a short, stout woman. Their weight may be the same, but the man will need quite a third more food than the woman, because he has at least a third more surface in proportion to his bulk, from which heat radiates out into the surrounding atmosphere and is lost to his body.

THE FATTER THE INDIVIDUAL THE LESS FOOD IS REQUIRED,

whereas the lanky youth and weedy girl will have what are called preposterous appetites if in good health; only by this large consumption of food can they make good the loss of heat from the relatively large surfaces of their thin bodies.

(4.) THE OCCUPATION OF THE INDIVIDUAL AS IT AFFECTS HIS DIET.

The proportion of food needed is actually more affected by work and rest than by any other factors. The harder the muscular labour, the more food must be eaten. A man performing very severe labour will require nearly twice as much food as the clerk in an office, and a third more than a man who is doing light work, such as a gardener. If the work is mental, not muscular, a very light diet meets the case. It should be of a specially digestible character, with a strictly moderate use of fats and carbohydrates. In these two points lie

THE ONLY REAL DISTINCTION BETWEEN THE FOOD OF A MANUAL AND OF A MENTAL WORKER,

the food of a labourer or of a student. The question is one mainly of quantity rather than of quality of the diet. The old idea, for instance, that fish was a "brain" food is without foundation, beyond the fact that whitefish is easier of digestion than meat. The brain and muscles both derive their nutriment from the lymph and blood, which circulate impartially over the whole body.

LIGHT FOOD ONLY AND IN SMALL QUANTITIES SHOULD BE THE RULE

when at rest, either on the train or steamer, or when in bed for some slight indisposition or trifling injury, or when taking a respite from work. In such cases also it is wise to consume fats and carbohydrates very sparingly.

Perhaps this point will be best illustrated by the following table, which shows the amount of body-fat utilized under different conditions of life; it brings out forcibly

THE RELATION BETWEEN WORK AND DIET.

One hour of sleep consumes 0.31 oz. of fat.

One hour of lying awake consumes 0.46 oz. of fat.

One hour of standing consumes 0.55 oz. of fat.

One hour of walking two miles an hour consumes 1.1 oz. of fat.

One hour of walking three miles an hour consumes 1.6 oz. of fat.

One hour of work on treadmill consumes 2.75 oz. of fat.

Toast, eggs, whitefish steamed, clear soup, light farinaceous puddings, and stewed fruit are advantageous foods for brain-workers, sedentary liver, or temporary invalids; remembering always that he who would gain the mastery must be temperate in all things.

(5.) THE FINAL CONSIDERATION IS THAT OF INDIVIDUAL IDIOSYNCRASIES,

the most inconvenient and unwelcome of all the requirements which the housewife is called upon to meet.

Fortunately, though we all have special favourites in flavours, there are very few healthy people who cannot eat and enjoy most plain fare. It may be that pork or goose are too rich for one; then let him eat more apple-sauce and less meat, he will be none the worse.

It is possible that boiled mutton does not appeal to another, or that parsnips are distasteful to a third. Such objections mean shorter commons at one meal, which will hurt no one.

BUT THERE ARE RARE CASES

where porridge or mackerel lead to subsequent vomiting; where eggs or shell-fish cause a rash, or where roast mutton acts like a poison. These idiosyncrasies cannot be overcome and must be humored; that is to say, provision must be made for that member of the family to ensure sufficient nutrition from other sources. To force down really hated food, far from overcoming the dislike, will only

It is well, if opportunity allow, to cultivate a taste for all kinds of food in youth. Quite often, children will be led to crave for the simplest pudding or the often detested green vegetables by introducing these dishes as special favourites of their elders, to be enjoyed only as a rare treat. In many cases they are provided for the child members only of the party, while their elders eat more highly flavoured fare; then the small folk are apt to conceive a dislike for their "ear-marked" diet which cannot be shaken, much to their loss then and in later life.

"PLEASE SUPPLY A SELECTION OF MENUS SUITABLE FOR ALL SEASONS"

has been a constant petition when this matter of the right arrangement of family meals has been under discussion. Now, such menus might be of interest, but they would be of small practical worth. Tastes and habits in the selection of forms of food vary conspicuously in different homes. The facilities for obtaining different articles of diet are quite as variable, so also are the prices. Eggs and milk may be purchasable at a reasonable cost to one inquirer, while they can only be used in very limited quantities by another. One family may, perforce, rely chiefly on salted meat and preserved fruits for several months of the year, while elsewhere fresh meat, game, and vegetables are always at hand. In one case

THE NEEDS OF CHILDREN CLAIM FIRST CONSIDERATION;

in another there are aged inmates to provide for; in a third case the household consists entirely of hard-working adults.

The result of a careful study of these two bulletins and of the diagrams with which they are illustrated should enable every woman of ordinary experience to select and combine suitable dishes for the nutrition of her household. For instance, no one would now dream of providing a corn and molasses pudding on a hot August day, but would arrange combinations intelligently, and with due thought of temperature, occupation, and age. If the meat course is cold, let the dessert be hot. If pork or roast beef be the chief dish, provide a light pudding, not one made with suet, for example.

With baked beans and pork a dessert of stewed fruit and a bread or cornstarch mould is appropriate. Dumplings are very suitable with vegetable-soup; and boiled jam-pudding is pleasant when cold mutton has preceded it on the table. A steamed batter-pudding with syrup or fruit may follow a dish of fish; and a simple rice or sago pudding is best if the meat course has been a rich one.

WHATEVER IS WORTH DOING IS WORTH DOING WELL.

There is no royal road to the provision of varied, palatable, wholesome meals any more than to any other duty in life. Each house-mother must keep her own wits sharpened, her own eyes on the lookout, her own ears alert, if she is to fulfill her obligations in this matter of the nutrition of her family. Most failures in these days result from want of thought, some are the offspring of ignorance. See to it that neither the one cause or the other exists in your own case.

ALICE RAVENHILL,

Fellow of the Royal Sanitary Institute; Certificated Lecturer National Health Society, Great Britain and Ireland. Author of "Practical Hygiene for Use in Schools"; "Elements of Sanitary Law"; "Some Characteristics and Requirements of Childhood"; "Household Administration"; "Household Foes," etc. Late Lecturer on Hygiene, University of London, King's College for Women.

NOTICE.

The Department of Agriculture is issuing the following series of bulletins prepared by Miss Alice Ravenhill, Shawnigan Lake, B.C., to be available for distribution among the members of the Women's Institutes throughout the Province:—

- No. 1. The Place and Purpose of Family Life.
- „ 2. The Preparation of Food.
- „ 3. The Preservation of Food.
- „ 4. Labour-saving Devices in the Household.
- „ 5. Food and Diet—Parts I. and II.
- „ 6. The Art of Right Living.
- „ 7. The Care of Children.

BULLETINS ISSUED BY THE DEPARTMENT OF AGRICULTURE.

- No. 7. Flax.
- „ 8. Feeding Farm Animals.
- „ 20. Varieties of Fruit Recommended. (Revised.)
- „ 25. Orchard Cleansing.
- „ 28. Production of Eggs.
- „ 29. Poultry Industry on the Pacific Coast.
- „ 30. Guide to Bee-keeping in British Columbia.
- „ 32. Control of Bovine Tuberculosis in British Columbia.
- „ 33. Fruit-growing Possibilities, Skeena River and Porcher Island Districts.
- „ 34. Fruit-trees and Black-spot Canker.
- „ 35. The Place and Purpose of Family Life.
- „ 36. The Preparation of Food.
- „ 37. The Preservation of Food.
- „ 38. The Construction of Silos.
- „ 39. Natural and Artificial Incubation and Brooding.
- „ 40. Alfalfa.
- „ 41. Labour-saving Devices in the Household.
- „ 42. Apiculture in British Columbia.
- „ 43. Women's Work in British Columbia.
- „ 44. Irrigation in British Columbia.
- „ 45. Agricultural Statistics, 1911.
- „ 46. Food and Diet—Part I.
- „ 47. Food and Diet—Part II.

Applications for bulletins published by the Department of Agriculture should be addressed to the Secretary, Department of Agriculture, Victoria, B.C.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1913.

PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF AGRICULTURE.

BULLETIN No. 48.

EXHIBITING FRUIT AND VEGETABLES.

—BY—

R. M. WINSLOW, B.S.A., Provincial Horticulturist.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1913.

DEPARTMENT OF AGRICULTURE,

VICTORIA, B.C., January 15th, 1913.

Hon. Price Ellison,

Minister of Agriculture.

SIR,—I have the honour to transmit herewith Bulletin No. 48, entitled "Exhibiting Fruit and Vegetables," compiled by R. M. Winslow, B.S.A., Provincial Horticulturist.

I have the honour to be,

Sir,

Your obedient servant,

WM. E. SCOTT,

Deputy Minister of Agriculture.

TABLE OF CONTENTS.

	PAGE.
Introduction	5
Exhibition of Fruit	5
Standards of Perfection	5
Score-card for Plates of Apples or Pears	9
Score-card for Plates of Peaches	10
Score-card for Plates of Plums and Prunes	10
Score-card for Plates of Seedlings	11
Plate Collections—Score-cards	11
Boxes of Apples, Pears, Peaches—Score-cards	12
Preparation of Fruit for Exhibition	13
Exhibition of Garden Vegetables	15
Standards of Perfection for Vegetables	15
Prize-list, Vegetables	24
Commercial Classes—Vegetables	25
Collection Classes—Vegetables	26
Adapting this Prize-list to Individual Fairs	26
Mixing Garden and Field Classes	26
Rules and Regulations relating to Fruit and Vegetable Sections ..	27
Prize-lists—Formation	28
Revision of Prize-lists	32

EXHIBITING FRUIT AND VEGETABLES.

INTRODUCTION.

FOR a number of years past the Horticultural Branch of the Department of Agriculture has been supplying judges for fruit, and to a certain extent for vegetables, for the numerous fairs of the Province. This was undertaken primarily in order to establish uniform and correct standards of perfection, which the indiscriminate choice of judges by each local fair had previously failed to do. The reports of the exhibition officials and exhibitors indicate that, to a very large extent, uniformly correct judging standards have now been established and maintained.

It is also the desire to use the information so acquired by the Horticultural Branch to modify the prize-lists of the different fairs in such ways as to promote the culture of the best varieties of fruits and vegetables by giving the greatest prize-money to such varieties; by providing for commercial displays in order to educate exhibitors in the commercial methods of packing; and generally to build up exhibitions by inspiring their officials to keep well abreast of the progress of horticulture in their districts.

The work of the Horticultural Branch has been of great assistance to exhibitors in the identification of varieties; in disseminating a knowledge of the various blemishes to which fruit is subject; and to a very large extent in promoting general information on what is ideal in fruit-production. This work, having been carried on for several years, has given general satisfaction. There has been a great improvement in the fairs, and the offer made by the Department to have the prize-lists of the various fairs revised at the end of each year by the Horticultural Branch has been generally taken up. This matter was discussed at the last Agricultural Fairs Association meeting at Victoria, and the following resolution passed:—

“Be it *Resolved*, That this meeting is fully in accord with the general principles of prize-list revision as stated before us by the Provincial Horticulturist, and we recommend that the various agricultural associations consult with the Department of Agriculture on the necessary revision.”

Our officials found much room for improvement in the choice of products for exhibition, in their preparation, nomenclature, and arrangement, and we have been able to make many recommendations in the revision of prize-lists. A general demand has been created for information along many of these lines, but more especially with regard to the score-cards used and the standards of perfection for the various types of fruits and vegetables, and it is to meet this demand that the present circular has been prepared.

EXHIBITION OF FRUIT.

STANDARDS OF PERFECTION.

The first step in preparing the exhibit of fruit is to get a mental picture of the ideal first prize exhibit. Of course, the entry must comply with the rules and regulations of the association, and be entered in due form and staged correctly on time and place; but the fruit itself must have a high degree of intrinsic merit if it is to excel in competition. There are certain standards of perfection which are accepted as ideal, and in proportion as the exhibits approach the perfect ideal they should receive awards.

The standards of perfection discussed here are the results of much experience. They have been reached as the result of observation during a number of years at the fairs of this Province and in the apple regions of the United States, and in them endeavour has been made to emphasize those qualities of fruit, in their proper relative proportions, which, when attained, give fruit pre-eminence.

In answering the question, What is the standard of perfection? we say of a plate of fruit that it must be free from blemishes and in good condition, of normal shape and size for the variety, and for purposes of consumption of the highest possible colour, uniform in all respects, and of high quality for the variety.

In collections of fruit there must be, in addition, correct nomenclature, commercial value, proper selection to cover the season, and the various uses in consumption, and attractive arrangement. For packed fruit there must be—in addition to the form, size, condition, uniformity, and freedom from blemishes—proper packing and attractiveness of package; so that standards take in many points, and must be discussed separately.

There are, however, certain principles upon which all our standards are based, and upon which our score-cards are prepared. These principles will be first discussed, and, following them, the various standards and score-cards separately.

THE SIZE OF FRUIT.

This is a point on which there is much misunderstanding. Many seem to consider that for exhibition the largest size is the perfect size. This is manifestly absurd. Fruit is mainly to eat, partly to look at, and its consumption value should rule in exhibition as in use. This principle has been in much confusion, but the point now stands as clearly defined. In some varieties of fruits, however, which in British Columbia do not attain the size they do in more southerly regions, the market demands the size to which it has been accustomed, and when this size is secured at only moderate sacrifice of quality and none of colour, as in plums, prunes, and peaches, the size should be large. The most desired sizes for each fruit will be discussed under their separate headings.

COLOUR.

Colour, like size, is an obvious quality of fruits, and is one in demand. Colour is popular because it appeals to the eye, and is also usually associated with quality. In all our fruits the highest possible amount of colour is demanded. At the same time it must not be secured at the expense of other qualities. Some very highly coloured fruit is so because of some injury to the tree, or from undue exposure of the fruit to sun or warmth. Such fruit would lose points on condition. The colour must be healthy and attractive, as well as high, and must be typical of the best in the variety. Any abnormality of colour scores low, on type and colour both.

FORM.

In shape, the fruit must be true to the type of the variety, as commonly known. Some varieties vary widely in different districts. In extreme cases the off-shape fruit must be scored down. In many varieties of irregular or unsymmetrical form, individual fruits may be chosen that excel in uniformity and regularity, and while they may score high on uniformity, they may be so off-type as to be disqualified for form. There is, then, a medium between the extremes that scores well both ways. For this reason it is desirable to choose fruits rather more uniform than the usual type of the variety.

UNIFORMITY.

This quality is most important in all classes of fruits. The individual specimens that comprise the entry should be as nearly alike as possible. They should each approach the common ideal, which ideal is, of course, the perfect one for the variety and for its intended use. Uniformity gives attractiveness to what, without it, would be a collection of unattractive specimens. Uniformity is also the fundamental of successful packing, and is the basis of fruit-grading; in itself it also helps to sell the fruit.

Uniformity applies to colour, size, shape, and condition. Some varieties of fruit are much more variable in shape than others, as, for instance, Wagener and McIntosh, as compared with Wealthy, Jonathan, and Northern Spy; and in such irregular varieties such perfect smoothness as is expected in the latter kinds is not typical of the variety, and so would lose points under "Form."

FREEDOM FROM BLEMISHES AND CONDITION.

It is a fundamental in exhibiting fruit that it should be perfect: free from all blemishes, whether they cause actual waste or merely disfigurements. This seems a most obvious axiom, and yet much fruit is shown with most apparent defects. Just how to deal with fruit infected with disease is often a problem with the judge, especially at fairs in new districts, or those where fruit is of secondary importance, as in many Coast sections. To disqualify all infected fruit would discourage earnest exhibitors, and would sometimes result in awards going to fruit much inferior in all other essential points. Our judges are therefore instructed to use their best judgment on this point, but to be as firm as possible, and to discourage the display of diseased specimens.

Blemishes are of four main sorts:—

(1.) Insect injuries, which are generally obvious. Most of these, especially the presence of scale-insects, should disqualify at once.

(2.) Fungous diseases, especially apple and pear scab, brown-rot of the stone-fruits, etc., for the display of which there is but little excuse.

(3.) Physiological troubles, prominent among which are fruit-pit (or Baldwin spot) and water-core, for both of which fruit should always be disqualified.

(4.) Mechanical injuries, such as hail-marks, bruises, punctures of the skin, etc. Many of these, especially slight bruises and healed-over injuries of any kind, are considered the least injurious. The absence of the stems is, however, evidence of gross carelessness and should disqualify exhibits of apples, pears, and plums, as it leads to early decay of the fruit. With prunes, it is hard to keep the stems on, and it is unnecessary, as breaking-off of the stem does not with these cause decay. In fact, prunes wither less where the stems are removed.

POLISHING.

Unless local regulations and sentiment are distinctly against wiping and polishing, apples and pears may be so prepared. We are aware that this practice is forbidden in the prize-lists of many of our fairs, but the rule is now much more honoured in the breach than in the observance. We believe that it is a regulation which might well be abolished altogether. The large shows all allow polishing. It really does not affect keeping quality.

CONDITION.

This refers to the stage of ripeness. Specimens of varieties past season should be in reasonably firm condition, and prizes should be awarded to the

entries not past condition at the show. Fruit-so far past season as to be unsightly should not be shown. Winter fruits are not supposed to be of mature eating quality at the fall fairs, but they should be firm and in a normal stage of growth for the time of year, not too far advanced, which indicates short keeping qualities, and not so immature as to suggest possible failure to properly mature before frosts.

QUALITY.

On the score-cards quality is the combination of flavour, sweetness, texture, etc., that constitutes edibility. The term includes the quality of the fruit for preserving or cooking, as well as for dessert purposes. It will be noticed that there is no place allowed for quality in score-cards for plates of one variety, or boxes of one variety. This is because it is assumed that all exhibits of one variety are equal in quality. If not, then the one more deficient in colour and condition would be of least quality, and would be scored down on those points. Where varieties compete against each other, however, the question of quality must be considered as of primary importance, and receives a place on the score-card in consequence. It is also considered in deciding on the merits of collections, and is very important in giving awards for the "any other variety" class, as well as that for seedlings or new varieties.

In commercial exhibits, quality also includes shipping qualities and the standing of the variety in the estimation of the market. The variety that ships best and is best liked on the market gets favourable consideration on these advantages.

In deciding on quality, which, by the way, is a very hard thing to define, and to quite a surprising extent a subject for a great difference of opinion, the judge does not test the different varieties, but gives each a score based on his knowledge of the general estimate of it.

With seedlings and new varieties, however, it is necessary for him to sample them, and make awards according to his personal judgment.

COMMERCIAL VALUE.

This is scored in collections only, as in box classes each variety is supposed to have a class for itself. The judge does not decide on the commercial value of the specimens on exhibition, but takes the general verdict of the markets to which the fruit of the district normally goes as to the average value of each variety. It is important to note that the commercial value of the variety as locally produced is considered, not its value as produced in fruit districts in general. Where a district is not yet at the marketing stage, the judge will make as correct an estimate as possible of the relative commercial values of the varieties in competition.

NOMENCLATURE.

Fruits shall be correctly named. In plate fruits, where it is assumed that all the plates are named (and this should be required), the judge may disqualify for omission or misnaming. In this latter case, he will, if possible, make the necessary correction. In collections, it is expected that there may be some defects in nomenclature, and scoring will be based accordingly. The names of varieties should be insisted on in all exhibits, and especially in collections and commercial displays, because their absence greatly detracts from the educational value of the decision. Labels should be neat, legible, and convenient to see, but should not be pasted or pinned to the fruit.

SEASON.

The period of time at which fruit is edible is its season. In most seedlings, or in "any other varieties," the longer-keeping variety would have the most

desirable season. With the seedling apple, we would give full points for one keeping into April or May. In soft fruits, the season of use should be long, so that fruit will hold up well, and it should come at a time when that fruit is likely to be in demand, or when there are no other desirable varieties. In collections for home use, the season implies a long range, from early till late, so that there should be a supply at all times throughout the year. In commercial collections, the varieties should include the principal commercial kinds, and especially those which come at a time of most demand. The commercial collection should, in other words, give a succession of varieties most in demand on the market at the times they are in demand.

PACKAGE AND PACKING.

For commercial fruit-production, packages and packing must be of the highest standard. The package must be adaptable to the fruit, reasonable in cost, sufficiently strong, and attractive. The packages used in British Columbia meet these requirements to a reasonable degree. Packing must result in a compact, firm, full, attractive pack. This will be considered in detail under the proper heading.

PLATES OF APPLES OR PEARS.

Size	15
Colour	25
Uniformity	25
Form	15
Freedom from blemishes and condition	20

NOTE.—Score-cards are not used for actual judging of plate fruits, except in the closest competition. The judge can carry in his mind the relative importance of the points mentioned. All judges are instructed, however, to use the score-card occasionally to secure harmony with it, and consequently uniformity.

Size (15 points).—Apples and pears should be of medium sizes. Jonathan and Spitzenberg should be about 13's; Snow and Cox's Orange, 17's; Spy and McIntosh Red, 12's; other dessert varieties in similar proportion. For showing in the United States, choose fruits one to two sizes larger, because in that country they have a fruit-stand trade that wants larger apples, and the American apple-box takes slightly larger sizes of fruit to better advantage. For Canadian conditions, we believe we are well advised in choosing the sizes as above for British Columbia. It is in medium sizes that the greatest quality, colour, and length of keeping are secured. There is a tendency in British Columbia to grow apples and pears to the oversizes, especially because most trees are young. In cooking varieties, larger sizes are demanded, as, for example, 112's for Rhode Island Greening. Varieties such as Alexander, Beiteghelmer, and Wolf River, whose large size is their recommendation, should be as large as possible, consistent with perfect colour, shape, freedom from blemishes, and condition. Size is not the most important factor, however, for colour, uniformity, and freedom from blemish are each given a higher score. Because it is such an obvious quality, however, it usually receives undue consideration. In many of the newer fruit districts, where most of the fruit shown is from young trees, consequently large and low-coloured, the awarding of prizes to fruit of proper size and colour gave apparent preference to the smallest fruit shown. Some exhibitors consequently went to the opposite extreme, and concluded that the smallest fruit was most desired, and were disappointed at the next exhibition on receiving no award against normal-sized fruit.

Pears are usually shown oversized; $2\frac{1}{2}$ inches in diameter is about correct for the Bartlett, $2\frac{1}{2}$ inches for Flemish Beauty, and other varieties in proportion.

Colour (25 points).—Colour should be as high as possible, consistent with the type of variety in the district. Red varieties of apples should be red all over. Blush varieties should have a good blush on the cheek. Green and yellow varieties should have as much red as can be secured, but the clearness of the green or yellow colour is of first importance in such varieties. Russet varieties should be evenly russeted all over, and bright-reddish russet rather than green. The same colour rules apply to pears as to apples.

Uniformity (25 points).—Absolute uniformity is desired, especially in colour and size, because these are the two main points in grading.

Form (15 points).—Form should be correct for the variety and district, but is not so important as colour and uniformity. It would be impossible to describe the correct type of each of the various varieties, even for one district, and the local type varies, especially between the Coast and the Interior. Generally, the apple which grows from the centre blossom of a cluster is most typical, and should be shown; in fact, to get uniformity in form and type, all apples should be so chosen. Type can only be learned by study and practical handling of the different varieties. In varieties of irregular form, an ideal rather more regular than the average is likely to be favoured, because of its uniformity.

Freedom from Blemishes and Condition (20 points).—The presence of fruit-pit and water-core is especially to be guarded against. Stems of all kinds should be intact, though the ends may be clipped if long.

PLATES OF PEACHES.

Size	20
Colour	25
Uniformity	20
Form	15
Freedom from blemishes and condition	20
	<hr/>
	100

Size (20 points).—Size is a more important point with peaches. The market demands them of the largest size. In the exhibition of late varieties, sizes from 60's to 72's are most desirable.

Colour (25 points).—Colour should be as high as possible, and specimens should be absolutely uniform in all respects. The form should be typical of the variety.

Freedom from blemishes is usually easy to get, but exhibitors must be careful to avoid split pits, which are very easily overlooked, while small bruises, not apparent at the time the fruit is set up, begin to show by the time it is judged.

In condition, the peaches should be firm.

PLATES OF PLUMS AND PRUNES.

Size	25
Colour	15
Uniformity	25
Form	10
Freedom from blemishes and condition	25
	<hr/>
	100

They should be the largest obtainable for the variety, consistent with other points. Colour should be typical in tone, uniform, and as high as possible. Uniformity is fairly easy to secure, and is expected in a high degree. In form the fruit should be smooth and typical of the variety.

Freedom from blemishes is important, and such things as split pit and gummy pit, as in Pond's Seedling, may be easily overlooked. The greatest care should be taken to have the stems intact in all varieties of plums, because usually when the stem is lost the skin is broken, and decay will set in. Slight skin-punctures not readily apparent will quickly lead to brown-rot in many districts. Fruit should be firm and in first-class condition. If brought from cold-storage it should not have any moisture condensed on it. Preferably, the bloom should be preserved. The stems need not be left on prunes.

PLATES OF SEEDLINGS AND FRUITS LISTED UNDER "ANY OTHER VARIETY."

Size	15
Colour	20
Uniformity	10
Form	15
Freedom from blemishes	10
Quality	25
Season	5

100

These are very unsatisfactory classes to judge. Plates of seedlings, to receive awards, should excel most commercial varieties under culture locally, in colour, uniformity, quality, and in season, while the specimens exhibited should have good commercial size, and especially should be free from all blemishes. As little or nothing as to their commercial value can be told from the plateful of apples, we do not consider this class of much value.

The "any other variety" class is eminently unsatisfactory to all concerned, for similar reasons. It is usual to award but one set of prizes for the whole collection displayed under this heading. Many good varieties go unrecognized, and their owners feel, justly, that there may be several plates each of which is perfectly worthy of first prize on its variety merits.

We recommend the abolition of this class from prize-lists. If a variety is worthy of a prize, let it be featured as a variety.

PLATE COLLECTIONS OF APPLES, PEARS, PLUMS, PEACHES, AND OTHER FRUITS
FOR HOME ORCHARD.

Size	5
Colour	15
Uniformity	10
Form	10
Freedom from blemish	20
Quality	15
Commercial value	10
Nomenclature	5
Season	10

100

In this collection, which is a very worthy one, and one which should be included in all prize-lists, there are the same requirements for size, colour, uniformity, form, freedom from blemish, and condition as are required of the individual varieties in their respective plate classes. As different varieties are shown in the different collections, however, their quality must be taken into consideration, and this is given 15 points. Commercial value is considered to the extent of 10 points, because a great part of the product of the home orchard should be of value commercially to provide for the sale of excess yields. A wide range of varieties over the season is desired, and so is a

range over the different uses to which the fruit is put—dessert, cooking, jamming, preserving, etc. Collections of not more than twenty-five varieties are expected, and a number of varieties beyond such limit should not be encouraged.

Nomenclature should be correct, for one of the greatest values of such collection is to aid new-comers and intending planters to choose the most desirable varieties for the purpose.

COLLECTIONS OF APPLES, PEARS, PLUMS, AND PEACHES FOR COMMERCIAL USE.

Size	10
Colour	15
Uniformity	10
Form	10
Freedom from blemish and condition	10
Quality	10
Commercial value	20
Nomenclature	5
Season	10

100

The requirements in this connection are in some respects like those of the previous one. The intrinsic merits of the fruit must meet commercial requirements, as discussed under plate fruits, but quality is less considered, and commercial value is given a higher score than in home collections. The requirements of season are somewhat different. Generally, a list of over ten varieties of apples or four of pears is not encouraged, while the longest keeping commercial kinds should be given most consideration.

BOXES OF APPLES, PEARS, OR PEACHES.

Fruit—

Size	10
Colour	20
Uniformity	15
Freedom from blemish and condition	15
Quality	15

75

Package and packing	3
Height at ends	4
Fullness or bulge	4
Solidity or compactness	5
Attractiveness and style of pack	5
Alignment	4

25

100

All box displays are intended to be in commercial packages, and the object of these box displays is to encourage the highest types of fruit and packing for market purposes. The sizes of the fruit should be those of the greatest commercial value, usually 104 to 128 to the box in such varieties as Jonathan, Spitzenberg, McIntosh, Wagener, Northern Spy. Large varieties, such as King, Alexander, Wolf River, etc., may go as high as 72 to the box, while small varieties, such as Snow, Cox's Orange, and Winesap, should be 175 to 188. The best commercial size for the variety should be the guiding rule. Markets for British Columbia fruit prefer 4- and 4½-tier apples. For American exhibitions, in standard dessert varieties choose the close 2—2 packs, 96-120.

The colour should be high, and it will be noted that colour is scored higher than any other point in commercial packages.

Under uniformity we expect fruit to be as even in colour, size, shape, and condition as it is possible to get. This is the foundation of successful grading. Moreover, in every respect, the fruit in the lower layers should be the same as those in the top rows. We are very glad to see that this rule is now very generally recognized in British Columbia, and it was extremely rare in this past season to find a box of apples that was not equally as good in the lower layers as it was in the top.

Freedom from blemishes is important in boxes, though it does not receive quite as high a score as in plate exhibits, and a slightly greater amount of blemishes is allowed.

Quality, for which 15 points is allowed, is taken into consideration only when two varieties are in competition. In single-variety entry quality is rated full points for all entries. When varieties compete, quality refers to commercial quality, market preference, and includes keeping quality and range of season as well.

Package and Packing (3 points).—The box should be of spruce rather than pine or other inferior woods; in all dimensions should be correct standard size, evenly cut, and with single-piece ends, sides, tops, and bottoms. In finishing, we expect it to be planed on the inside and the ends on both sides; proper cleats; properly nailed; put together to make a strong, attractive package. The wood must be clean. It is preferable not to have the brand exposed in box exhibits.

Height at Ends (4 points).—The bulge must slope gently to both ends, at which the fruit must be only about $\frac{1}{4}$ inch above each end. This is sufficient to provide tightness when the cover is nailed on. Lower ends may go slack, while, if higher, the fruit will be bruised by the cover.

Fullness or Bulge is allowed 4 points, which does not fully emphasize its importance. Boxes of peaches should be full up to the cover, but with no bulge. Plums and prunes packed in four-basket plum-crates should have a bulge of about $\frac{1}{8}$ inch. Apple-boxes should have a total bulge, top and bottom, of $1\frac{1}{4}$ to $1\frac{1}{2}$ inches. As small as 1 inch may be satisfactory on the very tight packs, while $1\frac{1}{2}$ inches is none too much on the open packs. Too great a bulge causes too much bruising, and too small a bulge means a light-weight box, and one that will not carry well. Pears require a heavy bulge, between 2 and $2\frac{1}{2}$ inches total, top and bottom, on account of the great shrinkage of pears in shipment.

Solidity or Compactness (5 points).—The pack must be firm and solid, so that the fruits are immovable in any direction. Full weight is expected.

Attractiveness and Style of Pack (5 points).—As packed, the box must be attractive, the wrapping smooth and even, with no torn papers; the general impression to be one of evenness, neatness, and uniformity. Of the three styles of packs, only the "diagonal" should be awarded a prize. "Square" or "offset" packs should be disqualified. A change of pack in the lower layers should also be disqualified. The pack must be regular and it must be the correct pack for the shape and size of the fruit.

Alignment (4 points).—The rows of apples, across, along, and diagonally, must be in perfect alignment. This is the final evidence of skilful grading and packing. Proper alignment greatly increases the attractiveness of the packs.

PREPARATION OF FRUIT FOR EXHIBITION.

The actual selection and preparation of fruit for exhibition is a matter in which a man should learn by experience. Actual practice and the results

of showing for a year or two seem almost necessary to the creation of the proper ideal in the mind of the intending exhibitor. The following are suggestions which in a great many cases would have given much better results if followed:—

(1.) Get a copy of the prize-list of the local fair as soon as it is published, and study it carefully. Mark the classes you expect to compete in.

(2.) Read and re-read the rules and regulations of the show. More mistakes are made from carelessness in this respect than any other. Some exhibitors do not seem to realize that the object of the rules is to make competition equal and fair, and when any exhibitor fails to comply with them and is still admitted to competition, he has an advantage to which he is not entitled. The rules should be complied with in making entry, in preparing the specimens for the show, and in actually setting up the exhibit at the right time and place.

(3.) Read carefully the paragraphs in this circular *re* score-cards and standards of perfection, and get firmly fixed in mind as nearly as you can what is required.

PLATES OF APPLES AND PEARS.

Require five specimens to a plate of one variety. It is best to select direct from the tree, choosing a dozen most like the ideal. Handle them carefully—cotton-wool is good. Keep early kinds in a cool place until exhibition, in cold-storage if necessary. Leave late kinds on the tree as long as possible. Pick crabs and other varieties of apples subject to water-core early enough to prevent its development. All apples and pears should be wiped before exhibition, and this is best done at the time fruit is being placed on the table.

For plates of plums and prunes twelve fruits are required. Choose a considerable number and select from them the most perfect twelve. Be careful to preserve the bloom, and on plums the stems also. If early varieties, stow carefully in a cold place. Avoid bruising, and handle as little as possible. At show-time select the twelve best, watching carefully for skin-punctures, slight bruises, and other places where rot may commence.

BOXED FRUITS.

After deciding what classes you are to enter, choose the fruit on the tree, using callipers to get the correct size for the pack you have decided to display. Handle fruit carefully into clean boxes, and remove to the packing-house. After the fruit has become cooled, pack the specimens best suited, wrapping all apples and pears except the top row, which should be packed unwrapped. Place thick felt paper above the top row, and nail on the lid, using cleats under it if necessary. For five-box, ten-box, and larger lots, fruits may be selected from the orchard run in the packing-houses, though this is most satisfactory if competition is to be keen. The show fruit may be selected from the boxes as the balance is packed, being placed in separate orchard-boxes and afterwards packed for exhibit.

When the top layer of apples and pears is wrapped for shipping to the show and is consequently somewhat slack when shown unwrapped, judges are instructed to make the necessary allowance.

In preparing for a show, skill and experience are bound to win. The novice may, however, by taking care to follow the hints given in this circular, and by observing their practical application in exhibitions, prepare some extremely satisfactory exhibits.

In general displays of fruit and in general district displays, much depends on the attractiveness and arrangement. This is a matter of art rather than horticulture, and one in which the rules of art govern.

EXHIBITION OF GARDEN VEGETABLES.

In British Columbia the home garden has not yet achieved the extremely useful though humble place to which its merits entitle it. There is not the proper conception of its possibilities as an economical producer of wholesome and nutritious food. In many districts it is almost altogether neglected, while even in those most advanced and scientific of intensive farming areas, the orchard section is not yet universally in favour. The fall fair can do a real service for its patrons by encouraging a well-grown display of garden products. For various reasons the vegetable classes have not been as popular as they should be. I mention the following as among the most prominent difficulties:—

(1.) There is much confusion and lack of information as to what is desirable in vegetables; this is true of all types, not more in anything than in the potato.

(2.) This confusion has been promoted by awards made by different judges from year to year.

(3.) Many prize-lists are not definite and clear. They lack classes for many good things, and in many cases group widely different things under single classes. The prize-lists need revision very much.

(4.) Prize-money is usually rather small, and just as much is paid for the unusual vegetables, for which entries are few, as for the standard and most useful kinds, in which competition is keen.

(5.) There has been little effort to get bigger displays, and not enough effort has been made to show the vegetable exhibits to proper advantage.

Commercial vegetable displays should also be encouraged. Our vegetable-crops are of greater total value than our fruit-crops, and we would venture to say that the market could be much further increased by cultivation of better kinds, and by better grading, preparation, and marketing. The fairs should foster a knowledge of and interest in commercial vegetable-production. They can very well do it by good prizes for vegetables in commercial packages, just as is being done in commercial displays of fruit.

The standards of perfection should be of much use in enabling exhibitors to show their best in the best possible way. The prize-lists suggested should be of use in enabling revision committees to amend their own in accordance with the requirements of the locality.

Shipping organizations should support any movement to educate the producers as to the market requirements in vegetables, by suggesting the most valuable classes and by assisting with prize-money. The secretary of the fair should give vegetable sections special attention and encouragement. School children should be interested by special prizes for them, for vegetables and flowers as well, grown and exhibited by themselves. There should be prizes for the best display by a settler in his first year, and also for settlers in their second year. Folks with town and village gardens should be encouraged by a prize for the best collection from such gardens.

STANDARDS OF PERFECTION FOR VEGETABLES.

UNIFORMITY.

The various specimens comprising an entry, or a package in a commercial exhibit, or a variety in a collection exhibit, should be uniform in size, form, colour, and quality.

SIZE.

Size should be moderate, not large; in fact, that size in which all the other qualities of the variety are found to their greatest perfection. In practically all garden vegetables, oversized vegetables are coarse and of low quality, and rough. Those under size are very often so because of poor culture, and then are often tough, of low quality, and even malformed.

COLOUR.

The colour should be bright, clear, and attractive. Colour in vegetables is a matter largely of condition, and it is a good index of how vegetables have been cared for.

FORM.

The principal requirement of form is that it should be economical with as little waste as possible. It must also approach the correct type of the variety, and be attractive to the consumer or purchaser.

FREEDOM FROM BLEMISHES.

This is not so important with vegetables as with fruits, but still it is very important. Potatoes should be, however, free from all diseases, such as blight, rot, scab, and rhizoctonia, all of which are far too commonly seen at the shows. All vegetables should be free from bruises and breaks caused by rough handling. This is particularly true of squash and others of that family.

CONDITION.

Condition should be good. Vegetables intended for long keeping must be firm, matured, and in every respect in apparently good condition for the purpose. Cauliflower and similar vegetables should not be past their prime, as is very often the case.

QUALITY.

This is the most important thing about vegetables. We cannot undertake to give a general score-card showing the relative importance of all these points, because they differ materially in different vegetables, but in every case quality would rank higher than any other point. What constitutes quality in each vegetable we will discuss under its separate heading.

Preparation of vegetables for show is a point which really should not be scored, because they should all be properly prepared. All root-vegetables should be washed free from dirt, fibrous roots and tops removed. Cabbage and cauliflower should be properly trimmed, and every vegetable should be so handled as to make it appear most attractive.

In commercial packages all the above points are of importance, and in addition we expect that the package will be clean, well constructed, and with the contents firmly packed and of full weight.

In collections of vegetables of all kinds, there are, in addition, to be considered the variety display, which should be large, sufficient to cover different uses throughout the season, and display should be made in an attractive and convenient manner.

It might be well with specially good winning displays of vegetables to have neat labels indicating the varieties of different vegetables for the general information of those in attendance.

POTATOES.

These should be uniform, particularly in shape and size. For most main-crop varieties they should run about 8 or 9 oz. in weight, this being the most

desirable average size for potatoes for general purposes. The colour should, of course, be typical of the variety, whether white, pink, pink-eyed, or red. The netted varieties, like Uncle Sam and Netted Gem, should be fully covered with thick netting. The skin of all varieties should be corky rather than smooth, indicating maturity. Where different varieties are in competition, the white-skinned are to be preferred above all others. In form, potatoes should be typical of the variety; but the most preferred commercial type is about $4\frac{1}{2}$ inches long, $3\frac{1}{4}$ inches wide, and $2\frac{1}{2}$ inches thick, rounded and smooth. The eyes should be few and shallow. There should be no evidences of second growth, and no green ends. Potatoes should be free from blemishes, especially from the fungous diseases, scab, blight, wet or dry rot, fusarium, wilt disease, or rhizoctonia, all of which appear too frequently on show potatoes. There should be no evidence of greenness caused by exposure to the sun. Potatoes must not be hollow.

Condition is largely a matter of maturity, and all varieties should be reasonably well matured for the season, as evidenced by thickness and toughness of the skin and internal evidences. When a knife-blade is sunk into a mature potato it pulls out hard, and the greener and more watery the potato, the easier it pulls out. When cut across, the potato should cut hard. There should be a minimum of water, and watery veins about the centre should not be in evidence. The maturity of potatoes is a very important point.

Quality.—While maturity is a big consideration in quality, much depends on other factors. The people of North America want a potato as dry and mealy as possible. The ultimate test, of course, is the baking test, and every show should have a class for six potatoes baked. Quality, aside from maturity and the amount of water present, is indicated by hardness in cutting, by the amount of starch, as indicated by milkiness of the sap when the cut surface is scraped, but chiefly by the depth of the "cortical ring." A very thin slice taken in cross-section from a potato and held up to the light will show a faint line of dots, about $\frac{1}{4}$ to $\frac{3}{8}$ inch from the skin. The wider the strip outside this line of dots, the higher the quality, and vice versa.

Generally, potatoes showing a slight yellowish tinge are of higher quality than those pure white.

In commercial exhibits, which should be in units, say of either 15-, 50-, or 100-lb. lots, there should be full weight, and the sack or package should be clean and general appearance attractive. In preparing exhibits of potatoes of commercial classes, the great points are correct size, uniformity, maturity, and weight.

ONIONS.

Onions should be uniform, especially in colour, size, shape, and maturity. For commercial purposes, the ordinary onion should be about $2\frac{3}{4}$ inches in diameter and nearly globular. The colour should be clear and distinct, whether yellow, red, white, or brown. It is most important to have maturity, which is usually the deciding point if there is any reasonable amount of similarity in other respects. Lack of maturity is shown by softness, especially around the stem end, and by the thickness of the stem. Onions should be uniformly hard, with small and thoroughly matured stems. The skins should be dry, firm, and intact. No "double-nosed" specimens should be shown.

The shape should be typical of the variety.

Pickling-onions, whether red, yellow, or white, should be firm, smooth, clean, and not over $\frac{3}{4}$ inch in diameter.

Shallots should be $1\frac{1}{4}$ to $1\frac{1}{2}$ inches in diameter, very firm and well matured, and of uniform colour.

When onions are cut across, which is not usually done in judging, there should be a large number of rings, and each of these should be as narrow as possible, and the centre white rather than green.

All the roots should be removed, and the stems should be cut off about $\frac{3}{4}$ inch from the onion. There should be no bruises or breaks in the skin, the outer layers of which should not be removed.

BEETS.

Garden beets must be uniform, particularly in colour, shape, size, and maturity. Though usually shown to much greater sizes, undoubtedly the best for all purposes is $2\frac{3}{4}$ to $3\frac{1}{2}$ inches in diameter, except in commercial exhibits, where they should be from 3 to $3\frac{3}{4}$ inches. The colour should be a deep red, and there should be as little waste from green top as possible. The form should be nearly globular for the globe beets, and typical of the variety in the long ones, which latter should be 6 to 7 inches long and about 2 inches in diameter. Beets should be free from blemishes, especially splitting, and a much-scarred heavy top, which is practically all waste. They should be prepared by washing. The top should be twisted off about $\frac{3}{4}$ inch from the beet, but the roots should be left on. It is desirable that the top should have been as small as possible, as evidenced by small stems.

Quality and inside colour are the most important points about the beet. When cross-sectioned, it should be red all through, with a minimum of white. It should cut easily, with an absence of fibre, and the rings should be numerous and narrow, while the flesh should be sweet and juicy as well as red.

Commercial exhibits of beets should comply with all the above requirements, save that quality is not given so high a place, and more emphasis is laid on uniformity, smallness of top, and correct size, as given above.

SWISS CHARD.

This is a member of the beet family, of which the stalks are edible. Six stalks should be displayed with the leaves left on. The stalks should be long, thick, white, uniform, tender, and clean; the leaves small in proportion.

CARROTS.

Garden carrots, as shown, should be very uniform, especially in size and form; the short varieties from $4\frac{1}{2}$ to 5 inches long, the intermediates from 6 to 7 inches, and the long from 8 to 9 inches. There is not much difference in colour, which should be bright and healthy in tone. The form should be tapering to a blunt point in the short types, but to a long point in the other types. Freedom from blemishes is usually easy to secure in the medium sizes mentioned above, the chief blemishes found being green tops and a splitting, due to too rapid growth. Carrots should be washed, the tops of the roots removed, and the stems twisted off. The top should be as small as possible, which is shown by the smallness of the scars left.

In commercial exhibits of carrots uniformity is most important. In size the specimens should weigh $\frac{3}{4}$ lb. each, while in form they should be short and thick.

Quality in carrots is indicated by taking a cross-section. The heart should be small and the flesh small-grained. As tested by taste, the flesh should be sweet and mild in flavour.

TABLE TURNIPS.

The swede varieties should be about 5 inches in diameter, with a small top, clean, uniform, free from all blemishes, especially the work of the fruit-

maggot, firm and smooth. The white and yellow varieties of the white turnips should be true to type, and in size medium for the variety.

In all types of table turnips there must be uniformity, smoothness, attractive appearance, good type, and, especially, freedom from insect injuries.

CABBAGE.

Two specimens are usually called for in each class of cabbage. They should be uniform with each other and of moderate size, the pointed kinds from 6 to 9 inches in diameter, the round varieties from 8 to 10 inches, the flat varieties from 10 to 12 inches. It is of most importance that both specimens be firm and solid and heavy, no matter how rigorously tested. In addition, they must be free from all insect injuries; the stalks should be removed and the outer leaves.

In commercial exhibits cabbages weighing from 3½ to 5 lb. each are preferred. They are stripped of their leaves more than is usual for exhibition purposes, leaving no waste from excessive leaves whatever. Packages must be well up to weight, viz., 200 lb. well filled with uniform, clean, smooth, and very firm heads.

Savoys should be 10 to 12 inches in diameter, and as well matured as possible. The same amount of firmness is not expected in these varieties as in the ordinary cabbage.

Red cabbage should comply with the general requirements for flat varieties, save that it should be of as deep a red colour as possible.

The showing of stock cabbage in garden classes is always to be discouraged.

BRUSSELS SPROUTS.

Two stalks each of brussels sprouts are exhibited, with a few of the outer leaves left on and the roots removed, but the sprouts must be numerous, large, firm, closely set, free from aphids and other insects, making as heavy a stalk as possible.

CAULIFLOWER.

The two cauliflowers called for should be uniform, especially in size, colour, and preparation; should be from 5 to 6½ inches in diameter, pure white in colour, smooth and regular in form. There should be no green leaves showing through the head, which should be quite solid and dense. Cauliflower past condition, as shown by softness and openness, should not be accepted.

In preparing cauliflower for show, remove the roots and all the leaves except some six or seven, which should be cut off just below the top of the head, leaving their bases as a protection for it.

SCOTCH KALE.

Two stalks should be called for, uniform, more especially in size, and the principal requirement is that they be vigorous, clean, and heavy, with large, dark, numerous, well-curled leaves.

RADISH.

The turnip varieties of radishes are exhibited in bunches of twelve. They should be washed and the roots and tops left on. They should be prepared as late as possible before the show, so as to prevent withering. The radishes themselves should be uniform, of clear red and white, smooth, free from root-maggots, and very firm. Their principal defect as shown is hollowness or softness, which can usually be prevented by moderate methods of culture and by selecting medium-sized specimens.

Long radishes must meet with the same general requirements, save that they should be the shape typical of the type.

SQUASH.

A great many varieties of squash and marrow are shown, under more or less confused headings, at many shows, and judging is in consequence very difficult and often unsatisfactory. To put this class on a better basis, we have recommended certain changes in the prize-list, embracing four varieties of summer squash and five winter varieties, which, together, give a complete range of quality over the entire season.

In garden squash, of which two of a kind are shown, there should be, principally, uniformity in size, colour, and shape, a moderate degree of size for the variety, and freedom from skin-punctures and similar blemishes, which are very destructive, especially to squash intended for winter storage.

The *Delicata* variety is the earliest vine type, and is a much superior quality to any of the bush varieties, which we believe it will largely displace as it becomes known. Specimens should be about 8 inches long, of the typical, somewhat pear-shaped type of the variety, and of good colour.

Summer crook-necks should be of deep-golden colour, about 12 inches long, and moderately crooked.

The scalloped or patty-pan squash should be about 8 inches in diameter, uniform, of clear colour, and are truest to type when the scallops are deep.

Vegetable marrows should be about 18 inches long, uniform, smooth and cylindrical, very slightly ribbed, of a uniform cream colour, and heavy.

Winter Types.—The Green Hubbard is the principal long-keeping winter squash. The pair shown must be uniform, especially in size, form, and as warty as possible. As the slightest blemishes are almost surely followed by decay, the entries showing such blemishes should be cut down heavily in proportion. The colour should be a deep black-green, with a minimum of white on the under-side. There should be about 1½ inches of stem attached. In size they should be about 14 to 16 inches long and 10 to 12 inches in diameter.

The Golden Hubbard must comply with the same general characters as the Green Hubbard, save in colour, which must be a deep golden-yellow.

For the Boston marrow, the same general requirements as to uniform size, trueness to type, freedom from blemishes, and stem apply as to the Hubbards. The colour and the form should be typical of the variety.

The green marrow is becoming rapidly more popular for early winter use. It is adapted to stewing, not to baking, like the Hubbards. The green marrows should be uniform, from 16 to 20 inches long, cylindrical and smooth, free from all blemishes, with 1½ inches of stem attached, firm, and well matured for the season.

Mammoth Chili.—Size and weight first; uniformity in colour and shape; of good type for the variety; flat side is not desirable. Other large varieties suited to culinary use might be entered with this variety; in such case the class to be called "Large Culinary Squash," as opposed to "Large Field Squash."

PUMPKINS.

The showing of field pumpkins in the garden classes should be discouraged. There are two principal varieties adapted to culinary uses, which should be grown throughout the Province, and which are as follows:—

Sugar Pumpkin.—This is the small yellow pumpkin. The two shown should be uniform, especially in size and shape, of a deep-golden colour, from 10 to 12 inches in diameter, and of a flattened, globular shape, free from any flat side, with 2-inch stem, free from blemishes, and in good condition.

Mammoth Tours.—This is the large green pumpkin grown for household use, and the two specimens submitted should be uniform, especially in size and shape. The very large sizes are not to be particularly encouraged, as they are inclined to be coarse and to weigh light. The colour should be clear and uniform. There should be no flat side.

LETTUCE.

There are three general types of lettuce commonly exhibited—the leaf, the head, and cos types. In all cases the heads should be large, clean, uniform, of proper colour, free from aphids. The roots in all cases should be removed, as well as the smaller damaged outside leaves; and the head should be washed.

In the head varieties the two heads should be of good size, firm, and white. The inner leaves of the cos varieties should form a good proportion of the weight, and should be well blanched.

CUCUMBERS.

Cucumbers are of two principal types—the long, smooth, dark-green, frame or greenhouse type, and the spine varieties, which are shorter, thicker, inclined to be three-sided, and characterized by whitish dots, which, in some varieties, are tipped by very short spines.

In both types there should be uniformity, moderate size, proper colour, good type, freedom from blemishes, and, above all, there should be a minimum of seeds and a great depth of flesh, as shown by cross-section.

In pickling-cucumbers, these should be uniform, of nice colour, on an average 2 inches long, and not tapered too much from stem to blossom end. They should be clean and the withered blossoms should be absent.

CANTALOUPS AND MUSKMELONS.

These two fruits are generally grouped together, but the term “cantaloup” should properly refer to the white-fleshed, soft type, the term “muskmelon” properly belonging to the firmer, yellow-fleshed varieties. In both cases there should be the usual uniformity in size and form. The netting should be well developed all over, and in cross-section the flesh should be of proper colour, white or golden-yellow, thick, and of high quality.

CITRONS.

The two citrons exhibited should be uniform in size, shape, and on a cross-section should show depth of flesh. This might otherwise be obtained by weighing them, but as facilities for weighing such fruits as citrons, squash, pumpkins, etc., are usually absent, it is more satisfactory to learn by a cross-section which is the heaviest. Size and weight are the important characters.

TOMATOES.

There may be classes for red, pink, and pickling tomatoes. We do not recommend the class of pink varieties, as they are going out of favour under the popularity of the red kinds.

The red and pink varieties should be uniform in size and shape. They should be true to colour, of sizes varying with the variety, but usually about 3 inches in diameter. The more globular forms are preferred. There should be freedom from blemish, especially blossom-end rot, splitting around the stem end, and open core. They should be firm in condition and should be exhibited with the stems removed.

Firmness is the most important point, and taken with it the thickness of the flesh, both of the outer wall and of the sections. The number of sections should be large and the amount of pulp and seeds limited.

Pickling-tomatoes, whether of the plum, cherry, or pear types, should be uniform in size, of proper type, and firm.

PEPPERS.

The principal varieties are the large green and the pickling. In the former class the two exhibited should be as large as possible, green, uniform, and should weigh up well.

In pickling-peppers the prize usually goes to the quart which is most uniform.

EGG-PLANT.

This is a class which is found only in the Dry Belt sections, and the award should go to the two which are largest and most uniform, firmest, and most free from blemish.

GARDEN PEAS.

In the class of "one quart of green peas in pod" the pods should be large, free from blemishes, very well filled with large, clean, whole, uniform peas, of deep-green colour.

The quality of the peas is the most important thing, and they should be very sweet and of high flavour.

In the class for "one quart of shelled peas" these should be uniform, deep green in colour, clean, whole, and of high quality, as described above.

BEANS.

A quart of green beans is usually supplied, and this applies equally to scarlet runners, broad beans, wax-podded bush, and green-podded bush, into which four classes this section should always be divided. In every case the pods should be of moderate size, uniform, of clear, deep rich colour, smooth, and in edible condition. They should especially be free from such blemishes as anthracnose.

Condition or quality as determined by snapping or by taste is the most important feature.

GREEN CORN.

Six ears of each type should be exhibited. We suggest dividing this class into white and "any other variety." The ears should always be stripped of the leaves, the stalk cut off close up, and the silk carefully brushed away. The ears should be uniform in length, diameter, and every other respect. The colour should be according to the class and variety, and should be clear and bright. The cob should be small and the grains should be long, closely set, and evenly distributed over the whole ear. There must be freedom from blemishes, and the quality must be high, as indicated by taste.

RHUBARB.

Twelve stalks, neatly tied, constitute an entry. They should be uniform, especially in size and colour. Size should not be too large, and the most preferable length is 18 to 20 inches. The colour should be red, bright, and attractive. The form of the stalks, of course, depends on the variety. All the stalks should be clean and trimmed top and bottom. They should be plump and fresh. Quality is indicated by the degree of toughness, and it is desirable that they should be as brittle, and therefore tender, as possible.

The commercial package of rhubarb should be the standard size, 20 by 15¾ by 7¾ inches inside measurements. It should be full and well packed, containing at least 40 lb. of rhubarb, and, better, 42 or 43 lb.

SALSIFY.

Six roots constitute an entry. They should be uniform, especially in size and shape. The size should be as large as possible, consistent with good type and appearance, the colour as nearly white as possible, form smooth and tapering. The fibrous roots and the tops should be removed and the roots thoroughly cleaned. There is no requirement for quality, but condition should be first-class.

PARSLEY.

A neat little bunch tied with string is all that is required. The colour should be deep green, bright, and attractive. The leaves should be very much curled and heavy. Neatness in preparation is an all-important point.

ARTICHOKES, JERUSALEM.

Six roots are required. They should be uniform in size and shape, should be as large as possible, consistent with soundness, smooth, free from blemishes, and in good condition. They must be clean. Quality requirements are much the same as with potatoes.

CELERY.

This class in celery-growing districts should be divided into white, yellow, red, and green or winter varieties. In commercial-celery districts it may be divided into variety classes. In each section six stalks are required, and uniformity is desired, especially in size, length of stalk, degree of blanching, condition, and colour. Most varieties should be as large as possible, consistent with good condition and firmness of stalk.

Colour is important; they should be true to the type of the variety in every case. White and yellow varieties should be shown blanched, and their colour must be pure, clear, and uniform. Red varieties should show the maximum degree of colour over greenish white. The winter green varieties should be natural colour for the time of season. They need not be blanched.

In form the bunch should be long and stout, but the stalks must be closely set and as many as possible of them should be full length. The roots should all be removed, the root-stock being trimmed down to the usual conical point, and the outer small or broken stalks should be removed.

Quality is most important, and is usually determined by a test of average stalks from each entry. The stalk must be firm, free from pithiness, solid, and heavy. It should not be stringy, but should be brittle and tender. There are not likely to be many diseases or blemishes, rust being the most important. This is heavily scored against, and badly affected entries should be disqualified.

In commercial packages of celery the medium-sized box, 28½ by 12 by 9¾ inches inside, is usually chosen. It should contain full weight, be attractive, clean, neatly prepared, and packed, solely of one variety, with cover nailed on; there should be a slight bulge.

COLLECTION OF SEASONING HERBS.

This should contain at least the five most important—sage, thyme, summer savory, mint, and sweet marjoram. A neat little bunch of each should be prepared, and for the benefit of the general public plainly and neatly labelled. There should be principally healthiness and vigour of growth, freedom from blemishes or diseased leaves, etc., and a proper stage of growth for the season.

FULL PRIZE-LIST, VEGETABLE SECTION.

Prizes.

1.	Potatoes, 6 each, 10 principal varieties, each variety..	3
2.	" 6 any other variety, white.....	2
3.	" 6 " " " coloured.....	2
4.	Onions, 6 yellow.....	3
5.	" 6 red	3
6.	" 6 white	2
7.	" 6 brown	2
8.	" quart of pickling, red	2
9.	" " " " yellow	2
10.	" " " " white	2
11.	" sets, quart	2
12.	" multipliers, quart	2
13.	" shallots	2
14.	Beets, 6 long	2
15.	" 6 globe	3
16.	Carrots, 6 long	3
17.	" 6 intermediate	3
18.	" 6 short	3
19.	Green corn, 6 ears stripped, white	3
20.	" 6 " " any other colour	3
21.	Table turnips, 2 swedes	3
22.	" " 2 white varieties	3
23.	" " 2 yellow "	2
24.	Cabbage, 2 pointed	3
25.	" 2 round	3
26.	" 2 flat	3
27.	" 2 savoy	2
28.	" 2 red	2
29.	Brussels sprouts, 2 stalks	2
30.	Cauliflower, 2 heads	3
31.	Scotch kale, 2 stalks	2
32.	Radishes, 12 turnip	2
33.	" 12 long	2
34.	Lettuce, 2 heads leaf	2
35.	" 2 " head lettuce	3
36.	" 2 " cos	2
37.	Squash, 2 crook-necks	2
38.	" 2 scalloped or patty-pan	2
39.	" 2 Delicata	3
40.	" 2 vegetable marrow	3
41.	" 2 Green Hubbards	3
42.	" 2 Golden "	3
43.	" 2 Boston marrow	2
44.	" 2 green "	3
45.	" 2 Mammoth Chili	2
46.	Pumpkins, 2 sugar	3
47.	" 2 Mammoth Tours	2
48.	Cucumbers, 2 long or frame	2
49.	" 2 spine	3
50.	" 1 quart pickling	3
51.	Cantaloups, 2	2

	Prizes.
52. Muskmelons, 2	2
53. Citron, 2	3
54. Tomatoes, 6 red	3
55. " 6 pink	2
56. " 1 dozen pickling, plum	2
57. " 1 " " cherry	2
58. " 1 " " pear	2
59. Peppers, 2 large green	2
60. " 1 quart pickling	2
61. Egg-plant, 2	2
62. Peas, 1 quart green, in pod	3
63. " 1 " shelled	3
64. Beans, 1 quart scarlet runner	2
65. " 1 " Windsor or broad	2
66. " 1 " bush, wax-podded	3
67. " 1 " " green-podded	3
68. Celery, 6 bunches white	3
69. " 6 " yellow	3
70. " 6 " red	2
71. " 6 " green or winter	3
72. Rhubarb, 12 stalks	3
73. Leeks, 12 stalks	3
74. Parsley, 1 bunch	2
75. Salsify, 6	2
76. Swiss Chard, 2 stalks	2
77. Collection of seasoning herbs	3
78. Artichokes, 6	2

COMMERCIAL CLASSES.

POTATOES.

In potatoes there should be liberal prizes offered for entries of 15, 50, or 100 lb., depending on the ability of the people of the district to select sufficient quantities and the amount of prize-money available. In such classes the amount of first-prize money should be about double the commercial value of the amount of first-class potatoes at the time of the show. Three prizes should be given.

BEETS AND CARROTS.

In sacks of 15, 50, or 100 lb. This prize would be of importance only in the districts producing these vegetables in commercial quantities. There should be two prizes.

CABBAGE.

One crate of 200 lb. net weight, ready for shipping. Three prizes.

TOMATOES.

One-crate, two-crate, or five-crate lots; 23 lb. net of fruit to the crate. Three prizes. The four-basket crate should be used.

ONIONS.

In sacks of 15, 50, or 100 lb. Three prizes.

RHUBARB.

One box, 40 lb. net. Three prizes.

COLLECTION CLASSES.

- (1.) Collection of garden vegetables grown by a settler in his first year.
- (2.) Collection of garden vegetables grown by a settler in his second year.
- (3.) Collection of garden vegetables grown on a town or city lot by an amateur.
- (4.) Collection of vegetables from a rancher's vegetable garden.
- (5.) Collection of vegetables grown by school children on gardens cultivated by themselves.

Classes for school children might be made in potatoes, onions, beets, and other types of vegetables, as well as this collection.

The object of prizes for collections of vegetables is principally to stimulate an interest in the home garden by making better known what can be produced, and by encouraging those who intend to exhibit to maintain the garden for the necessary season.

COMMENTS ON ADAPTING VEGETABLE PRIZE-LIST TO INDIVIDUAL FAIRS.

(1.) We recommend strongly that the quantities specified in each class be followed. These have been adopted in harmony with the larger shows and in general practice, but in the younger associations there is a tendency to adopt unusual quantities, so causing considerable confusion.

(2.) It will be noted that three prizes are indicated for some classes and only two prizes for others. In those classes of greatest value, in which competition is usually greatest, three prizes are indicated, and we recommend that the first-prize money in this case should be worth trying for, say \$2.50. The object in making three prizes is that a reasonable proportion of the exhibitors should get a sum of money. Where two prizes are indicated, the competition is usually less keen, because the vegetable mentioned is less important. In these cases the first prize should be about half that of the major classes, say \$1.50, and no third should be given, because there is usually not nearly as great competition. These prizes should not, however, be made so small as to discourage exhibitors. The idea is that in the more important classes prizes should be increased slightly, and in the minor classes they should be decreased slightly, as compared with present practice, in both cases being increased as the finances of the association warrant. The importance of the different classes varies with the locality, and the classification into major and minor given here will have to be adopted with discretion.

(3.) Many classes here named would be of little or no use in many districts, such as egg-plant and tomatoes in many Coast and cooler Interior sections. In such cases the Revision Committee should not include such kinds. In other cases, as in pickling-tomatoes, the three classes might very well be made one; the same with pickling-onions. Much will depend in such cases on the adaptability of the district, the amount of prize-money available, and the amount of competition that is likely to be secured.

MIXING GARDEN AND FIELD CLASSES.

One of the most common causes of confusion in vegetable classes in the fairs of the Province is the mixture of field and garden produce under one heading. These should by all means be kept separate, and it will be noted

that no field produce is included in the above list. In order to make the definition clearer, we give the following list of field products which should be kept under a separate heading from garden products:—

Mangels, globe.	Heaviest pumpkin.
„ intermediate.	Squash, field.
„ long.	Kohl Rabi.
Sugar-beets, stock.	Stock cabbage.
Stock carrots, white.	Thousand-headed kale.
„ „ yellow.	Sunflowers.
„ „ red.	Field-beans.
Pumpkins, field yellow.	Hops.
„ „ green.	

RULES AND REGULATIONS RELATING TO FRUIT AND VEGETABLE SECTIONS.

In order to simplify the task of the committee whose duty it is to make such rules and regulations and provisions as will result in fair competition and the harmonious operation of the show, there is submitted here the most important of those rules, which, if followed, would result in satisfaction to exhibitors in these classes.

RULES REGARDING ENTRIES.

1. Intending exhibitors must give notice by duly filling in the proper form (furnished, on application, by the Secretary) and returning it to the Secretary not later than (three days before opening date of show). No entries will be received after that date. Entries must be made in the names of the producers or manufacturers, only by them or by their duly accredited agents.

2. Entries must comply with the rules and regulations, and exhibitors must conform with the requirements of their respective classes. This Association recommends exhibitors to secure copy of the Department of Agriculture's circular on "Exhibiting Fruits and Vegetables" for information on preparing material for exhibition.

3. Entries must be the property of the exhibitor. Produce should have been grown by exhibitor; and preserves, jams, canned goods, etc., should have been manufactured in the establishment of the person exhibiting.

4. All fruits and vegetables must be clean, sound, and properly prepared for exhibition. The Association reserves the right to refuse acceptance of any entry, without stating reasons.

5. All varieties of fruits and vegetables must be correctly, neatly, and legibly named. Failure to do this renders exhibits liable to disqualification.

6. All entries in fruit and vegetable classes should be staged by 7 p.m. of (the day previous to opening day).

7. On the entry of each exhibit, a card will be furnished the exhibitor, specifying the class, definition, and number of entry, which card must remain attached to the exhibit during the exhibition.

8. The Association's officer in charge will direct the placing of all exhibits, and exhibitors must strictly obey the instructions given. The Association is responsible for having all entries in each class staged together.

9. No individual member should stage more than one entry in any one class, and no one exhibit shall be entered in more than one class.

10. The Association will provide plates for all plate exhibits, and only these may be used. Exhibits shall not in any way be allowed to carry any marks that may identify their ownership, except in the case of district exhibits.

11. *Judges.*—Judges will be supplied by the Association in conjunction with the Department of Agriculture. No person shall act as judge in any classes in which he exhibits or is interested. Judges shall hand in their awards in writing, properly signed, to the Secretary. Before leaving the city each judge shall ascertain from the Secretary whether there are any protests against any of his awards, in order that he may duly present to the Board his reasons for the award.

12. *Protests.*—Any protest must be lodged with the Secretary in writing within four hours after the awards have been announced. The decision of the Directors on all matters designated under these rules shall be final. A deposit of \$5 is required with all protests, to be refunded if the protest is sustained.

13. In addition to the stated premiums offered in the prize-list, the judges may recommend additional premiums as they may consider worthy, and the Board of Directors will then determine whether such premiums shall be awarded, and the amount. Judges may also distinguish such exhibits as they may consider deserving of notice, but which have not received prizes, by ticket bearing the words "Highly Commended."

14. *Withholding Awards.*—In the absence of competition in any section, or if the articles exhibited be of inferior quality, the judges are instructed to award only such premiums as they consider merited. They may exercise their discretion as to whether they will award first, second, third, or any premiums.

15. Growers are invited to exhibit such productions not specially mentioned in the prize-list as are likely to be of interest, as novelties, or for any other cause. The Association does not undertake to vote awards for such exhibits, but in cases where such exhibits are recommended for awards by the judges, the Directors may grant extra awards of such amounts as they may decide.

PRIZE-LISTS.

The fall fair has several important functions: To promote social intercourse; to provide amusement; to advertise the advantages of the district; and to stimulate the culture of the best kinds and types of agricultural produce by exhibiting what is being produced, and by awarding prizes to those of greatest merit.

Of these various functions, it is probable that the fruit and vegetable sections are most valuable in promoting the culture of the most meritorious products, and their principal aim is therefore educational in character.

To systematize the showing of products and so to distinguish those of greatest merit, it has been found necessary to issue lists of products, and by rules and regulations to guide exhibitors into making uniform entries, which can accordingly be judged on their merits, not only by the judges, but by the more casual onlooker as well. The prize-list names the various products and the awards attached to them, and it thus becomes one of the most important factors, almost the central factor, of the show's organization.

On the prize-list much depends, for, if it is seriously defective, the usefulness of the show is lessened, exhibitors become disheartened, and the whole organization, instead of being each year a fresh inspiration to better things, becomes moribund, incapable of educational value, and even a drag on progress. It is therefore important for the welfare of any annual exhibition that its prize-list should be formed in accordance with correct principles, and that to meet changing conditions of development, finances, and educational efficiency, the prize-list should be given careful annual revision.

The following are the more important principles on which useful prize-lists for fruit and vegetables are based:—

(1.) Fruit and vegetable classes should be pre-eminently educational in character, demonstrating the perfection the district attains, or could attain, in the best products for commercial and home use.

(2.) In plate exhibits of fruit, larger prizes should be paid to the best commercial and home-orchard varieties. From eight to fifteen of these, depending on the district, should get three prizes, while second-class varieties should get two prizes only; the first prize in the latter case to be one-half the amount of the first prize in the first group. Miscellaneous varieties of limited value, usually far too numerous already, should not be included, or at most should be given little more than recognition.

(3.) Similarly, the more important types of vegetables should receive more prizes and larger money than the minor types. This is discussed more fully under the "Vegetable Prize-list."

(4.) The regular prize-list should provide for exhibits of commercial packages and packing, with a view to raising the local standard. Depending on the district, the amount of money given for commercial displays should vary in proportion to the commercial possibilities and progress of the district. The amounts of the awards and the sizes of exhibits should be in line with the commercial value of the various varieties and the possible development of the district.

(5.) There should be prizes for certain collections, both of home and commercial fruits and vegetables, but great care should be taken in making these collections, so that they may be of genuinely valuable character. The list of collections given below indicates the most valuable ideas.

(6.) Score-cards for judging should be uniform throughout the Province and in harmony with the rest of Canada. The score-cards given in this circular have been prepared by our Horticultural Branch in co-operation with the fruit-growers' associations of Ontario, Nova Scotia, Prince Edward Island, and the Dominion Department of Agriculture.

(7.) In general, the conditions of entry should harmonize with those of the larger exhibitions, so making each local fair a training-school for the larger fairs of Provincial or international importance.

(8.) Fairs should endeavour each year to add any new types of exhibits of educational value.

(9.) Apple-packing contests and other new features of great educational value should be provided for all fairs where the opportunity exists.

SPECIAL CLASSES—FRUITS.

1. *Commercial Classes*.—One-box, two-box, five-box, and ten-box exhibits of the few best commercial varieties of apples, with prize-money at least double the commercial value of the best exhibit.

In pears there should also be one-box, two-box, and five-box exhibits, and the same with plums and prunes. In peach districts there should be two-box displays, while in districts where other types of fruit are produced largely enough to make commercial exhibits desirable, we should have encouragement along the same lines.

These exhibits should be prepared in harmony with the score-cards given in the first part of the circular.

2. *Collection Classes*.—A collection of plates of apples for home orchard, to be judged according to the requirements of the score-card.

Collections of plates of apples of commercial value, to be judged by the score-cards given for such commercial collections.

Collections of apples for home use may be subdivided into five varieties of fall apples and five varieties of winter apples, or this may be still further subdivided for collections of fall dessert, fall cooking, winter dessert, and winter cooking apples. These collections may all be scored on the points given above. There should, in addition, be prizes for the best collections of three varieties of fall pears on plates, and the best five varieties of winter pears on plates, also the best collection of plums, limited to five varieties, twelve specimens to a plate. All the varieties in these sections should be plainly and correctly labelled, or be disqualified.

The pyramid of ninety-one apples makes a very attractive display, and may very well be included in those districts where large, fine, high-coloured apples are grown.

3. Packing contests should be included in all districts where commercial apple-packing is carried on, and for these the following rules are suggested:—

- (1.) The management of the fair to furnish necessary tables, paper, boxes, and apples for the contest, as follows:—

- (a.) One table for each competitor, about $3\frac{1}{2}$ by 4 feet dimensions, with burlap cover, after the usual pattern:

- (b.) Standard Canadian boxes, 10 by 11 by 20 inches inside dimensions, care being taken to have boxes properly made of correct material, as the character of the box materially influences the work of the packer:

- (c.) Paper: For each packer about 3 lb. of paper, 9 by 9 or 9 by 10 inches in size, depending on apples:

- (d.) Apples: Six boxes Grade No. 1, 150 to the box and larger, and graded to afford variety of pack.

- (2.) Entry fee of \$1; entries to close about one week before fair. Contestants to draw lots for places and numbers.
- (3.) Apples to be placed on the tables by disinterested persons, aiming to place on each table a fair average of the whole lot.
- (4.) All apples to be packed diagonally in the standard Canadian boxes.
- (5.) Each contestant to pack three boxes, time to be taken when contestant places last box on the floor.
- (6.) To secure perfect or 20 points for speed, the contestant must pack the three boxes within twenty-five minutes, every three minutes longer will reduce the score two points, and if not finished within sixty minutes, the contestant will be ruled out.

The following score-card to apply:—

Speed	20
Uniformity	15
Alignment	10
Bulge	10
Height at ends	10
Firmness	20
Wrapping	15

100

4. *Special Prizes to encourage High-class Packing.*—Two-box or five-box display of apples or pears of one variety, commercially packed, all layers wrapped, covers to be removed in the presence of the judge, scoring to be made as follows:—

Grading	25
Packing	75 (subdivided in the usual way).

100

5. *Displays of By-products.*—The history of successful horticulture on the western coast of America is largely the history of the successful development of canning, preserving, drying, and similar processes. This is most strikingly illustrated in the oldest sections, as in the State of California, whose fruit by-products now reach an annual value of \$28,000,000; the present unimportant place occupied by industries based on these processes in British Columbia is comment enough on the newness of fruit and vegetable growing in this Province. To develop the so-called “by-product industries” is one of our big problems. In educational work along this line, the fall fairs should do much that they are not at present doing. They have a special opportunity in stimulating an interest in home canning, preserving, and pickling. They could also encourage the display of the products of the small canning and other plants now beginning to start up in many sections. We consider that among the following there are many classes which should secure a place on the average prize-list:—

HOME PRODUCTS.

Canned Fruits in Glass—

	Prizes.
1. Raspberries, red, 1 quart	3
2. Strawberries, 1 quart	3
3. Raspberries, black, 1 quart	2
4. Preserving cherries, 1 quart	3
5. Sweet cherries, 1 quart	3
6. Plums, 1 quart	3
7. Peaches, 1 quart	3
8. Pears, 1 quart	3
9. Apples, 1 quart	3
10. Apricots, 1 quart	3

Preserved Fruits in Glass.—There should be prizes for displays of the above fruits in this class as well, but perhaps the prizes would not be so large, and probably two would be sufficient.

Jams in Glass—

	Prizes.
1. Red currant, 1 pint	3
2. Black currant, 1 pint	3
3. Strawberry, 1 pint	3
4. Red raspberry, 1 pint	3
5. Plum, 1 pint	3

Jellies.—Collection of four varieties, *named*, in jelly-glasses.

Vegetables, canned in Glass.—Collection of five to ten varieties. There should be good prizes for this collection, which should include tomatoes, peas, corn, carrots, beets, rhubarb, and beans.

	Prizes.
Home-made wine	3
Raspberry vinegar	3
Mixed pickles, sweet, 1 pint in glass	3
Mixed pickles, sour, 1 pint in glass	3
Collection of pickles, four varieties	3
Catsup, 1 pint in glass	3
Chili sauce, 1 pint in glass	3
Pickled onions, white, 1 pint in glass	3

COMMERCIAL BY-PRODUCTS.

There should be liberal prizes and diplomas for the best display of fruits and vegetables, canned, jammed, dried, and pickled, etc., by factory being

operated to offer these products commercially. These factories help a great deal to give stability to the fruit industry, and it is to the advantage of all to encourage them.

REVISION OF PRIZE-LISTS.

The judges of fruits and vegetables at each fair, on its conclusion, reported to the Provincial Horticulturist, enclosing a copy of the prize-list, indicating the number of entries in each class, and making recommendations on many points connected with the exhibits themselves, and with the organization of the fair, its prize-list, rules and regulations, arrangement, etc., which has put at our disposal a great deal of information that should be of value to every fair in preparing for a larger exhibit next year.

The officials of the Horticultural Branch are at the service of Revision Committees to assist them in making their prize-lists and the rules and regulations more educational and more progressive. This work in the past has had the sympathy of all fairs, and has had the heartiest support from those which are most progressive. The recommendations which are made in this circular have been largely gleaned from experience in the judging of fairs in this Province.

It is hoped that arrangements can be made for the judges of fairs, especially those who are connected permanently with the Horticultural Branch, and the Provincial Horticulturist, to confer with fair officials throughout the Province, so as to give more direct assistance in recommendations and in revision.

The Horticultural Branch is arranging to deliver lectures throughout the Province on fruit-judging and exhibition standards. We expect that this work, especially with the hearty co-operation of each fair, will not only increase the educational value of the fairs, but will greatly stimulate the number and quality of the exhibits and the interest and attendance, so creating a greater degree of local support for our fall fairs.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1913.

DEPARTMENT OF AGRICULTURE
(LIVE-STOCK BRANCH).

PROVINCE OF BRITISH COLUMBIA.

MARKET POULTRY

BULLETIN No. 49.

BY

H. E. UPTON, ASSISTANT POULTRY INSTRUCTOR,
Assoc. O.A.C.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C. :

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1913.

DEPARTMENT OF AGRICULTURE
(LIVE-STOCK BRANCH).

PROVINCE OF BRITISH COLUMBIA.

MARKET POULTRY

BULLETIN No. 49.

BY

H. E. UPTON, ASSISTANT POULTRY INSTRUCTOR,
Assoc. O.A.C.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C. :

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1913.

DEPARTMENT OF AGRICULTURE,

VICTORIA, March 8th, 1913.

Hon. Price Ellison,

Minister of Finance and Agriculture,

Victoria, B.C.

SIR,—I have the honour to submit herewith for your approval Bulletin No. 49, entitled "Market Poultry," compiled by H. E. Upton, Assistant Poultry Instructor, dealing with co-operation in marketing of poultry products, ideal standards of the different breeds of poultry, fattening for market, feeds and feeding, balanced rations, etc., which it is anticipated will be of material assistance to all those engaged in this profitable and rapidly growing branch of farming.

I have the honour to be,

Sir,

Your obedient servant,

WM. E. SCOTT,

Deputy Minister of Agriculture.

A type of general-purpose stock.

PROVINCE OF BRITISH COLUMBIA.

DEPARTMENT OF AGRICULTURE.

(LIVE-STOCK BRANCH.)

HON. PRICE ELLISON,
Minister of Agriculture.

W. E. SCOTT,
Deputy Minister of Agriculture.

W. T. McDONALD, B.Sc., B.S.A.,
Live-stock Commissioner.

H. RIVE, B.S.A.,
Dairy Instructor.

J. R. TERRY,
Chief Poultry Instructor.

H. E. UPTON,
Poultry Instructor.

A. KNIGHT, V.S.,
Chief Veterinary Inspector.

S. A. K. WHITE, V.S., W. W. ALTON, V.S., R. B. ILSLEY, V.S.,
Veterinary Inspectors.

WM. J. BONAVIA,
Secretary of the Department.

MARKET POULTRY.

BY H. E. UPTON, POULTRY INSTRUCTOR.

INTRODUCTION.

WHEN one walks through the many markets that handle poultry products and closely observes the quality and condition in which dressed poultry is displayed for human consumption, he quickly asks why the stock is so lean and bony, or why it looks so bad, sometimes even mouldy. With the exception of a few markets which handle specially fattened stock, the majority handle stock which has been in cold-storage for some length of time. Good storage require-

ments must be had to keep dressed poultry in its prime condition if being held for any length of time before marketing.

Another bad feature arises from the fact that much of the dressed poultry has not been properly fitted before it goes into storage. Some specimens have had to be cut open in the breast in order to remove the crop, which was full of grain before being killed. Other specimens have bones which stand out very prominently, denoting that the stock has neither been bred for market poultry, nor has it been fed in such a way as would make the product more edible. Fowls should be bled if they are not intended for immediate consumption after killing.

The poultrymen are in a state of unrest at the present time as to the disposal of their surplus cockerels. If the light-weight cockerels (that is, Leghorns, Minorcas, etc.) have not been hatched at the proper time, it is as well to sell them for whatever they will bring. July and August broilers do not return enough for their keep. To have the stock hatched on time and cater to the

A finished roaster. Compare with following illustration.

market requirements would mean a greater profit to the poultryman, and also help advance poultry-growing towards the system which must come if the best is to be gained.

Heavy-weight varieties have not been too highly recommended in some parts of the Province because of the difficulty one has had previously in marketing the products other than eggs. With the increased prices of foodstuffs and the existing scarcity of the same, there will ever be a growing demand for more and better-dressed poultry. We feel that the producer should be placed in touch with the situation, thus instructing the consumer to demand a better grade of dressed poultry and help to eliminate so much cold-storage stuff from our markets, a goodly amount of which is not produced in British Columbia.

CO-OPERATION.

While the demand for dressed poultry and poultry products is growing, there is an opening for the progressive poultryman or a body of progressive poultrymen to work together and cater to a market which, when once educated to the quality of good poultry products, will pay a premium to the producer. The producer will thus benefit himself, other producers of good stock, the markets, and also the consumers.

There is very little profit for the individual poultryman to fatten or plum up his surplus stock for market, but there is certainly a grand chance for many of the small producers in districts to combine and send their stock to one centre. At this centre the stock may be fattened and marketed in a more uniform and attractive appearance. With an unlimited amount of produce to market, there is greater chance for selection and grading than when there are only a few dozen fowls to market or a few dozen eggs to be sold. The Cowichan Creamery, of Duncan, has done exceptionally good work in handling the surplus stock for producers in that vicinity. All its patrons are well pleased with the results which have been obtained. It is to be hoped that several other of the associations will combine together and market their products on a business basis, whereby they will also derive the many benefits from co-operation.

A cold-storage fowl. Notice the dried, shrunken appearance.

STOCK FOR MARKET POULTRY.

All breeds and varieties are not suitable for market poultry, for there are several which do not hold in combination within themselves the power to lay a goodly number of eggs as well as being a nice table-fowl, although feeding has much to do in the securing of a good marketable fowl. One must practise selection

in the breeding stock to get a framework on which to produce the flesh. If males have been selected that have long breast-bones, well covered with flesh or muscle to the tip of the bone, and mated with females which compare favourably to the detailed standard which is given, one should produce chickens which are good utility birds, having well-covered breast-bones. Greater gains are made by marketing roasters than probably any other form of dressed poultry which is sold.

From practical experience, the writer feels he could recommend the following breeds and varieties for general-purpose stock:—

Plymouth Rocks. — There are five varieties in this breed, the three most popular being the Barred, White, and Buff. This breed is undoubtedly one of the best farmer's fowl which we have. The best strains are good winter layers, fair summer layers, and make exceptionally good roasters. They are very hardy and good sitters. The standard weights are: Cock, $9\frac{1}{2}$ lb.; cockerel, 8 lb.; hen, $7\frac{1}{2}$ lb.; pullet, $6\frac{1}{2}$ lb.

Wyandottes. — There are several varieties in this breed, the most popular being the White, Buff, Silver Laced, Columbian, and Partridge. This breed has practically the same characteristics as the Plymouth Rock, but is a little more blocky in type. Wyandottes make good broilers and roasters. They are good mothers and fair sitters. They lay a goodly number of eggs, though the writer thinks that the old strains lay a better number of eggs than the later strains, which have been bred much shorter in the back than the old type. The standard weights are 1 lb. less than those of the Plymouth Rocks.

Rhode Island Reds. — There are two varieties of this breed, Single and Rose Comb. Their body is much longer in appearance, and not so massive as the Plymouth Rock and Wyandotte. They

A pair of good general-purpose fowl.

are hardy, good winter layers, fair summer layers, but do not seem to be as good sitters as the two above-mentioned breeds. The standard weights are: Cock, 8½ lb.; cockerel, 7½ lb.; hen, 6½ lb.; pullet, 5 lb.

Orpingtons.—This breed differs in colour of leg and skin from the above three mentioned. The more popular varieties are the Buff, White, Black, and Jubilee. The Buff and White seem to have taken a greater hold with American and Canadian poultrymen than have the Black or Jubilee. They are exceptionally good winter layers, and make good roasters and fair broilers.

Dorkings.—This is one of the oldest English breeds we have, and are an exceptionally good type when bred by standard requirements of a utility fowl, being long in the body and short in the legs. They lay large, white eggs, and are good sitters.

Sussex and one or two other varieties will do very well from the dual-purpose standpoint in some parts of the Province. We would not recommend either Sussex, Dorkings, or Faverolles for the cold, damp parts of the Province, however, because they are less hardy.

Strain and individuality play an important factor in each case. There is often as remarkable a difference between two strains of one breed as exists between two breeds of different origin. In an experiment which was conducted along dual-

(A.)

(B.)

Note prominent head and breast of (A) compared to (B); also his pronounced appearance, denoting strength and vigour.

purpose lines, pure-breds gave higher profits than scrub stock. In crate fattening, the pure-breds made a greater gain in live weight, and the cost of the feed for them was less than that of the scrub stock. They also appeared to be much more uniform, and had a more saleable appearance. (Re. Dom. Poultry Bulletin No. 54, p. 53.)

One can breed quite successfully most varieties of poultry for a certain ideal, so long as constitutional vigour and stamina are given the first choice in selection. A good utility standard is given in the following lines, which will help one to select their breeders:—

(a.) *General Appearance*.—Weight: Cock, 7 to 8½ lb.; hen, 5½ to 7 lb. Form: Long, moderately deep, broad, low set, rectangular, and well balanced. Quality: Bone moderately fine and clean, feathers soft and medium in quantity,

skin fine, and scales fine. Condition: Face and head appurtenances bright red, eye bright, feathers glossy. Style: Active and vigorous, but not restless, showing strong character.

(b.) *Head and Neck*.—Comb: Medium in size, fine texture, even and well attached. Beak: Short, stout, broad at base, well curved. Face: Short and full, clean cut, short distance between eye and beak, distance well filled in; head broad at crown, eye clear and full, bright red or bay in colour; appendages medium size, fine and smooth. Neck: Moderate in length, well arched, good flowing hackle in male.

(c.) *Body*.—Shoulders: Broad, and rather flat on top. Back: Broad, width well carried back, good length, with a gentle concave sweep to tail. Breast: Deep, wide, full, and round; fleshing abundant over breast and extending to point of keel. Keel: Long and straight, well covered with flesh over entire length. Tail: Well spread and full, not pinched.

(d.) *Legs and Feet*.—Size: Medium in length, plump, well muscled, set well up on the body. Legs: Straight, short, wide apart, strong in bone, but not coarse. Toes: Medium in length, straight, strong appearance.

A good comparison of strong and weak young stock.

breast-bone has a framework on which a goodly amount of meat can be grown. It is the breast and keel of the fowl which make up the frame on which the greater part of the meat of the market-fowl is found. If one pays strict attention to the above points when selecting breeding stock, we will not have so many triangular-shaped specimens in our yards.

Notes on Standard.—The above standard, while not calling for much explanation, would be more clear with one or two detailed explanatory notes for the beginner. Any specimens possessive of a long, crow-shaped beak should not be used in breeding. Diagrammatically speaking, we prefer a U-shaped breast-bone, it being deeper and broader and should be free from crooks. With a breast-bone of this style we have a good breeder for utility stock, as also a nice-looking table-bird when dressed. A bird possessing a keel which is long and straight, in conjunction with the above-mentioned

FATTENING MARKET POULTRY.

The market price received for the ordinary lean or unfitted chicken is so small that the profits which might be obtained from a little extra work are given no attention. It is estimated that from 60 to 80 per cent. of the live weight of the unfitted chicken is unedible matter; so, also, the consumer must pay a high price for nothing more or less than offal. Many breeders of general-purpose stock know that after experimenting themselves and studying the records of many stations, the greater profit is realized from stock that is fitted and marketed in first-class condition. There are, however, many breeders who still market their surplus stock alive, or, if dressed, in poor condition. Either of these methods means a loss to the producer. It is for their benefit, as well as for the betterment of market conditions, that the subject of fattening is given so much detailed description.

There are several methods employed in different parts in fattening poultry, but the pen and crate methods seem to be the ones in vogue throughout the Dominion and the United States. The cramming-machine is used in some places to make a more prime roaster, but for the farmer or small commercial man the use of this machine is not advised. From the writer's experience, better success, in conjunction with a more even product, has always been obtained with the crate method. Crate fattening is more economical than pen fattening, though pen fattening is usually resorted to because of the lack of proper facilities for the other method. A very

easily made and efficient fattening-crate can be constructed of laths, with a few light boards from a packing-box or soap-box used for ends and partitions. The standard crate measurements are:

6 feet 6 inches long, 18 to 20 inches high, and 16 inches wide. The top, back, and underneath parts are formed of laths running lengthwise. The laths on the top and back should be about $1\frac{1}{2}$ inches apart. The slats on the front should run up and down, being placed 2 inches apart, so that the birds may eat from the V-shaped trough in front of the crate. The laths on the underneath portion are placed $\frac{3}{4}$ inch apart. The back slat should be placed at least $\frac{3}{4}$ inch from the last slat on the underneath portion, so that the droppings will pass through upon the floor, rather than accumulate in the crate. A V-shaped trough 2 inches deep and $2\frac{1}{2}$ inches wide at the top (inside measurements) is placed in front of the crate on

brackets, or it may be hung on two pieces of hay-wire, the trough being raised about 2 inches from the level of the underneath portion of the crate. After the crate is finished it may be placed upon stands or upon legs about $2\frac{1}{2}$ to 3 feet

The Cowichan fattening-crate.

off the floor. Nothing, however, should be placed in under the crate, thus keeping the birds in a more sanitary condition. The crates should be disinfected, after each crateful of birds has been disposed of, with some good, strong disinfectant. At the end of each season it is well to scrape the manure from the crates and give them a good washing with boiling water, thus holding to sanitary laws.

The fattening-crate used by the Cowichan Creamery (as shown in the cut) has the following dimensions: Length, 10 feet; width, 20 inches from outside slat;

height, 20 inches over all. There are five rows of laths placed lengthwise on top. These are placed about $2\frac{1}{2}$ inches apart. Seven rows of 1-inch stuff, the edges of which have been skived down, are nailed on to the bottom of the crate about $1\frac{1}{2}$ inches apart. A piece of 1-inch stuff should be centred on the bottom, the other three on each side being nailed equal distances apart. The back and three centre partitions are solid, made of two pieces of 1 by 8-inch shiplay. All other framework is made of material 2 inches by $\frac{1}{2}$ inch, except end braces. Inch and a quarter nails are used in the lathwork and 2-inch nails for the rest of work.

In constructing the front of crate, each compartment of which has five pieces of laths up and down, one piece 16 inches long should be centred in the middle of the compartment stationary, and two placed at equal distances on each side of same, nailed permanently. The centre lath works as a door by nailing two pieces horizontally across the two laths which have been nailed on either side of the stationary piece, and driving two nails on either side of the centre lath itself to hold same in firm upright position, yet allowing play enough for easy working up and down.

The material required for such a crate is as follows: 29 laths 49 inches long by $1\frac{1}{2}$ inches wide; 4 feet of $1\frac{1}{4}$ -inch material planed for braces at top and bottom ends to attach laths to; 70 feet of 1-inch stuff for bottom pieces; 20 feet of 2- by $\frac{1}{2}$ -inch material for bottom and top front brace to which partitions and front laths are secured; 36 feet of 1- by 8-inch rough shiplay for partitions and back; 1 lb. $1\frac{1}{4}$ -inch nails; 1 lb. 2-inch nails.

A crate this size allows five compartments of 20 by 22 inches inside measurements. The feed-trough measurements are the same as for the standard crate.

The objectionable features of the pen method are many. When a number of birds are placed in a house or small coop, there naturally is a tendency to move around and walk over each other; hence much of the food eaten is wasted by supplying energy to the bird for its movements. In crate fattening, one can guide the feed much more readily, keep the birds in a smaller space, have them in a more sanitary condition, and keep the room darker, preventing so much restlessness.

There are several little details, however, which should be given consideration as to the handling of the stock before placing them in the crates. A bird weighing from $3\frac{1}{2}$ to $4\frac{1}{2}$ lb. pays better returns than a heavier or lighter bird, when crate-fattened. Stock should have reached this weight when from the age of four to four and a half months.

EXPERIMENT 1.

Experiment to show results of fattening immature stock and mature stock of weights recommended:—

Number of Cockerel.	Weight when put in Crate.	Weight at End of First Week.	Weight at Killing-time.	Total Gain.
Leg-band.	Lb. oz.	Lb. oz.	Lb. oz.	Lb. oz.
60	3 8	3 7	4 6 $\frac{1}{2}$	0 14 $\frac{1}{2}$
+13	3 9	3 6	5 4	1 11
+67	3 12	3 12	4 14	1 2
+0	3 0	2 14	3 14	0 14
223	4 7	3 13 $\frac{1}{2}$	4 12	0 5
236	3 3	3 0	3 14 $\frac{1}{2}$	0 11 $\frac{1}{2}$
255	3 8	3 5	3 14	0 6
275	5 5	4 15	5 7	0 2
276	4 1 $\frac{1}{2}$	3 13 $\frac{1}{2}$	5 0	0 14 $\frac{1}{2}$

Brown-Upton, University of Maine, 1910-11.

Notes on Above Figures.—It must be remembered that individuality will play a large part in all cases. Birds Nos. 60, +13, and +67 made good gains, comparatively speaking. Birds Nos. 275, 255, and 223 made very poor gains. The quality of flesh was much improved, but the stock was range-fed too long before fattening. The above results are a few specimens experimented with out of several crates.

In selecting for size, one desires to fatten birds which have practically attained their full growth of framework. A fair amount of meat should be developed on the body.

Crate fattening will yield a good profit to the man who pays strict attention to the three above-mentioned factors when selecting his stock. Even if they be not crate-fattened, but shut up in the house for two or three weeks' time, they will yield more profit than when range-fed.

FEEDS AND FEEDING.

As to the method of feeding that is generally used in fattening poultry, it would probably be well to mention one or two of the little details that come up before placing the birds on a genuine fattening ration. We would advise one to start feeding a little wet mash to the surplus stock when on the range for a week or two before placing them in the crates. By this method the crop becomes more

Cut showing crammage-machine used at the Cowichan Creamery and Fattening Station.

enlarged, and the digestive system is made more adaptable to handle the wet mash, and more of it, when they are placed in the crate. After this time of preparation the birds should be dusted well with a good lice-powder, to prevent the irritation which would undoubtedly cause loss of weight when in the crate. They should then be starved twenty-four hours before giving them the first feed.

Begin feeding the birds with a very small quantity of food, usually about 2 oz. of the mixture at the first feed, then increasing the amount gradually each day, keeping the birds hungry at all times, though having the birds always eager to eat. Oftentimes a good feeder can make the stock eat as high as 36 oz. of grain to the twelve birds at a feed. The eighteenth or nineteenth day of fattening in the crate is usually the last day when the birds can be forced to eat a greater amount of food. From this time on the birds gradually eat a smaller amount, so therefore they should be starved, dressed, and marketed immediately. At this time some English fatteners begin to use the cramming-machine on the stock for a week or so, in order to put an even more prime roaster on the market than the crate method has produced.

EXPERIMENT 2.

Experiment to show loss and gain in weights on relative days:—

Bird's Number.	Weight when put in Crate.	Weight after Two Days.	Weight after Five Days.	Weight after Seven Days.	Weight after Nine Days.	Weight after Eleven Days.	Weight after Fourteen Days.	Weight after Sixteen Days.	Weight after Eighteen Days.	Weight after Twenty Days.
	Lb. oz.	Lb. oz.	Lb. oz.	Lb. oz.	Lb. oz.	Lb. oz.	Lb. oz.	Lb. oz.	Lb. oz.	Lb. oz.
234	4 10	4 4	4 2	4 3	4 4	4 4	4 6	4 7½	4 10½	5 0
239	4 3½	4 3	4 1½	4 2½	4 3	4 3	4 7	4 9	4 12	5 0
240	4 0	3 14	3 14	3 12	3 13	3 13	4 1	4 3½	4 5	4 11
241	4 6	4 4	4 4	4 2½	4 7	4 7	4 14	4 15½	5 0	5 3
242	5 6	5 3	5 0	4 11	4 15½	5 0	5 2	5 3	5 6	5 14½
245	4 1½	3 13	3 11	3 11	3 12	4 0	4 4½	4 6	4 6	4 8
247	4 6	4 2	4 0	4 ½	4 0½	4 4	4 6	4 8½	4 12	5 0
258	3 15½	3 10	3 11	3 12	3 11	3 12½	3 14	3 15	4 3	4 12
259	4 4½	4 0	3 15	4 0	4 2	4 4	4 4	4 6	4 11½	5 5½
260	4 2	4 1	3 13	3 13½	3 14	3 15½	4 0½	4 6	4 6	4 9½
262	4 9	4 8	4 6	4 6	4 6	4 7½	4 10	4 11½	4 15	5 5½
267	4 4	4 0	3 13	3 12½	3 14	4 0	4 3	4 5	4 9	4 12½

Brown-Upton, University of Maine, 1910-11.

When the above experiment was conducted, the experimenters wanted to see exactly what happened during the fattening periods. The writer admits the results are nothing alarming. Yet, considering the stock was handled over so much and still put on good gains, one can readily conclude that good profits can be made from crate fattening.

The feeds which are generally employed in fattening are barley-meal, cornmeal, low-grade flour, shorts, and white middlings. Ground oats are also used by many, but they yield a larger profit for the amount fed when the hull has been sifted out. The mash is usually mixed in the proportion of 1 lb. of the mixed ground grain to 1½ lb. of the sour, skim, or butter milk. It is well to mix the food about twelve hours before feeding, thus letting the food cream, so to speak, which renders it more easily digested, on account of the bacterial action which takes place within the food. If skim-milk, or milk in any form, cannot be obtained, it is well to soak some beef-scraps in hot water, and use the liquid in the place of the milk. Several different rations have been used and given out as being profitable. However, there are many detailed factors that the person engaged must give attention to when he fattens the stock. The following rations are some which have been termed successful by many:—

Ration No. 1.—Cornmeal, 3 parts; ground oats, hulls sifted out, 1 part.

Ration No. 2.—Oatmeal, cornmeal, barley-meal, equal parts of each.

Ration No. 3.—Cornmeal, 3 parts; white middlings, 1 part; ground oats, 1 part.

Ration No. 4.—Ground oats, 2 parts; ground barley, 1 part; cornmeal, 1 part.

Ration No. 5.—Ground oats, 200 lb.; white middlings, 100 lb.

Notes on Rations.—No. 1 is probably one of the most profitable rations to feed in fattening when cornmeal can be got cheap enough. If the stock be well matured, a person could afford to pay \$2 a hundred for cornmeal, if there were enough birds to make fattening a paying proposition at all.

Ration No. 2 is very good. It would work very well in cold weather, and yet produce fat on the birds. In warm weather a ration like this is to be discouraged.

Ration No. 3 is very good.

Ration No. 4 has given good results wherever used.

Ration No. 5 is that which is used by the fattening-station at Cowichan. Stock to be fattened in colder climates would fatten at a cheaper cost on Rations 1 and 2. For warm seasons or that which is experienced for about nine months out of the year in that district, the ration works to good advantage.

Some experiments have been conducted by feeding dry ground grain to the birds in the manner that the wet mash would be fed when fattening. They were also given access to drinking-water as suited themselves. It was observed that the birds seemed to choke when eating the dry grain. Naturally, they would become ravenous when fed in this way, and would therefore try to eat too much at a time. Though only conducted twice, conclusions were to the effect that this was not a profitable method of fattening. An experiment was also conducted by the writer, in which twelve males were put in a pen 8 by 10 feet and fed whole grain, with milk to drink, for three weeks' time. The result was that the texture of the flesh was not improved

A neatly packed box of dressed poultry.

in any way, but the stock weighed more at the end of the period of fattening than when put in. The results tended to prove that more profit would be obtained from stock fed in this way than when marketed directly from the range.

CAPONIZING.

We do not think that caponization is a profitable practice to the small producer, under the present market conditions. The same amount of time used by the small producer in fattening will pay better returns.

PREPARATION OF STOCK FOR MARKET.

Not infrequently does a producer have hard work to market his produce because of the slack appearance it has when being sold. If the producer does not spend a few moments in adding to the neatness and attractiveness of his article, he is throwing a share of his profits away. For example, if a poultryman has a dozen fowls to market, and throws them in his wagon on a bran-sack, and another dozen are packed in a box lined with clean parchment paper, with their feet and heads washed, the contrast is quickly noted by the buyer. The producer will thus obtain a premium over and above those which are marketed in a slack condition. Though 2 cents a pound on a few birds may not be a very large factor, on a commercial basis it is the small amount which counts up fast and displaces many of the debits to the credit side.

STARVING BEFORE KILLING.

Too often, well-fatted roasters have their crops full of grain when marketed. The crop and entrails, as also the meat around the same, soon begin to turn green,

Dislocating the neck. Note the head is turned to right angle with neck, breaking the joint by a pull downward.

due to the bacterial action which is caused by the food souring. Although the body of a fowl should never be placed in contact with water, the housewife is justified in washing the carcass of a bird that has not been starved, with soda-water, in order to sweeten the meat.

It is policy to starve all fowls for twenty-four hours before killing them. At about the twelfth hour of fasting, one should give them a drink of water, to wash out the digestive system.

KILLING AND PLUCKING.

If poultry is to be used soon after killing, there will not be much danger of disintegration set up by the blood which lodges at the base of the brain from dislocating the neck. Some believe that the bird does not bleed properly unless it has quite a long neck, on account of the fact that all the flowing blood has only this small crevice to run into.

If the stock is to be held for a certain length of time before marketing, it is advisable to use a method of killing which will rid the body of the blood as it is in circulation when death occurs. To meet this demand, the following method, with diagrams, is given after the experimental work conducted by the United States Department of Agriculture * as to the best methods with best results obtainable. This method is endorsed by commercial poultrymen, colleges, experimental stations, and many experts. When killing, the bird should be suspended from the ceiling or rafters by a stout cord attached to its legs, to the height of the picker's chest, as shown in cut. A blood-cup is usually hooked through the nostril of the bird, in order to catch the blood. By this practice the blood is kept from the feathers, which may be used as a by-product. Almost any kind of a knife will work well, but it is better to have a knife which is about 2 inches long and a $\frac{1}{4}$ inch wide, with a thin, flat, but strong handle, and a blade which may be sharpened on both

Bleeding. Note the way knife is held in right hand and blood-cup attached by hook through nostril.

A good killing-knife. Exactly half-size.

sides, with a very sharp point. Having it sharpened on both sides, one does not need to turn the knife when braining the bird after it is bled. The fowl's head is held lengthwise in the killer's hand, in an inverted position, and the knife is run in just beyond the bony surface of the head, then the jugular vein is cut on the left side when the bird's head is upside down in the hand, as shown in the illustration. If the cut is made properly, the bird bleeds profusely. After this the knife is centred in the groove located in the centre of the roof of the mouth. The knife is placed downward in the groove, and then pushed backward into the bony structure of the head to the distance that might be explained as between the eye and the ear of the

* Circular No. 61, United States Department of Agriculture.

bird. A sharp half-turn will paralyse enough of the brain-tissue to kill instantly and loosen the feather-muscles. This is all done so quickly, especially by the adept picker, that the bird has no chance to suffer from the practice. Plucking should be

Diagram of fowl's head, showing the cut for bleeding, as also groove for braining.

commenced at once, pulling the body-feathers first, then the wing and tail feathers. As soon as the fowl is rough-picked, the pin-feathering and finishing can be done more quickly in a sitting position.

In the stool method, which is used by some of the large packing-houses, the picker usually stuns the bird with a club; then it is bled from the outside by cutting the jugular veins. The brain is pierced from the outside, also, at the same distance employed in the string method from the inside. It is really a dirtier method than the string pick, but when one acquires the knack it can be done more quickly.

DRESSING MARKET POULTRY.

In dressing poultry for market, dry-picking is a system which gives better results than steaming. It is in the outer layer of the skin of the chicken that one finds the taste so peculiar to this sort of meat. When a bird is steam-picked, this taste is taken away, because the outer layer of tissue is wholly destroyed. It should be a person's aim, when picking a chicken, to have it in its best condition and ready for the oven after it has been drawn. Several ideas and methods have been advanced regarding the best method of removing the feathers, but if the picker, when plucking, pulls the feathers in a backward position from which they grow, he will gradually work out a system of his own.

Picking and finishing.

SHAPING.

After fowls have been plucked, the picker should wash the blood from the head and the dirt from the feet and shanks with a damp rag; then place them on the shaping-board as shown in the illustration. The shaper is made by nailing two

A three-tier shaping-board.

$\frac{3}{4}$ - by 6-inch planed boards together at right angles. The trough should be nailed into a frame and incline slightly backwards. With legs placed alongside the breast and the breast downward, force the bird into the angle of the shaper, cover with paper, and lay a brick or something heavy on the back and something on the side, to hold it in position. The shaping should be done in as cool a temperature as possible without freezing, and should be continued for at least twelve hours.

HOW TO MARKET.

Poultry should be marketed with their heads on and in an undrawn condition. In the larger markets of the East, dressed poultry will not bring as high a price when it has been drawn or the heads removed. The head is the health-indicator of the bird, so, thus, removing the head from the fowl might give a suspicious intention. If the entrails have been drawn from the bird, one might also suspect that it was sick before being killed. Birds marketed in this way would pick up dust and bacteria of all forms.

COOLING.

There are two methods of cooling. One is to leave them on the shaper, and the other is to plunge the birds in ice-water to cool more quickly. When the fowl is plunged in cold water the body takes up much moisture, and, although it gives a more plump appearance, the gloss is destroyed from the skin, and if the carcass be held unfrozen for any amount of time it becomes hard and has a dried-out appearance. If dressed poultry is to be chilled or frozen, the low temperature

must be constantly maintained until the product is to be consumed. Fluctuating temperatures will cause a condensation of moisture, and allows the bacteria and enzymes to perform their destructive work on the dressed carcass. The United States Department of Agriculture is doing quite extensive work with storage relative to poultry. For the ordinary poultryman it suffices to mention that poultry should not be held for any length of time in a damp room. If the product be stored, the temperature of the room should be held at an even degree, generally stated as below 40° Fahr. or 4° Cent.

Fowl on board, showing the correct placing, with brick as weight.

After removing poultry from storage in a frozen condition it should be thawed gradually, by hanging the same in a cool place for about twenty-four hours. When frozen poultry is plunged into water in order to thaw it, then soon eaten, it has a flat or rancid taste. Dressed poultry should never be refrozen, if a good, edible article is desired.

The object of cooling poultry is to get the animal heat out of the body as soon as possible. Bacterial action takes place quickly in the warm carcass.

PACKING AND MARKETING.

When thoroughly cooled, the birds should be packed in shipping-cases made of basswood, spruce, or ash. If possible, we recommend the use of spruce or ash

A good method of packing twelve birds.

in making the boxes. Pine and cedar are liable to taint the flesh. When ready for use, the boxes should be lined with parchment paper. It tends to prevent evaporation, and also keeps the birds and boxes clean.

Several methods of packing are in vogue, but the three most common in the East are the breast, back, and side packs. The following set of dimensions will assist any who are desirous of making their own boxes, whether it be individual or association packing:—

No.	Inside Measurement.	Thickness of Sides.	Wood Ends.
0	19 $\frac{3}{4}$ " x 15 $\frac{5}{16}$ " x 4"	7/16"	9/16"
1	21 $\frac{1}{4}$ " x 16" x 4 $\frac{3}{16}$ "	7/16"	9/16"
2	23 $\frac{3}{16}$ " x 16 $\frac{5}{8}$ " x 4 $\frac{5}{16}$ "	7/16"	9/16"
3	24 $\frac{13}{16}$ " x 17 $\frac{5}{16}$ " x 4 $\frac{5}{8}$ "	7/16"	9/16"
4	26 $\frac{1}{4}$ " x 18" x 5 $\frac{1}{4}$ "	7/16"	9/16"

Case No. 0 is for 12 chickens weighing (plucked) from 2 $\frac{1}{2}$ to 3 lb.

"	1	"	"	3	to 3 $\frac{1}{2}$	"
"	2	"	"	3 $\frac{1}{2}$	to 4	"
"	3	"	"	4	to 4 $\frac{3}{4}$	"
"	4	"	"	4 $\frac{3}{4}$	to 5 $\frac{1}{2}$	"

The packing should be done in such a way that the shape the shaping-board has given the stock will be retained. By following the above dimensions when constructing the boxes for packing, the packer will be able to send out an attractive package that will stay firmly packed with ordinary handling.

Not more than one grade of poultry should be placed in the same box. The grade and weight of enclosures in the box and full shipping directions should be marked on the outside, and also on a slip placed on the inside of the box.

Although we have no standard at the present time for dressed poultry, the following grades are recognized in every market:—

Broilers.—Should weigh from 1 $\frac{1}{4}$ to 2 $\frac{1}{2}$ lb. each. Stock weighing under this figure come under another head, and stock weighing over 3 lb. belong in the roaster class.

Roasters.—Should weigh from 5 to 10 lb. or more at the end of the season. They are sometimes classified as medium, small, and large roasters.

Fowl.—Embraces all other kinds of dressed poultry when marketed, whether yearling (males or females) or more.

SHIPPING LIVE POULTRY.

For those who ship poultry alive, whether it be for immediate killing or not, overcrowding should be avoided. Overcrowding is not only cruel, but the stock loses weight quickly, as well as deteriorating the quality of the meat.

A suitable crate for shipping fowls alive.

If coops were constructed of laths or slats on the top and sides the weight of the coop would be very much lightened, and the stock could secure more fresh air. If over fifteen head are to be shipped in one crate, a partition of slats will keep the stock from huddling and sweating in one corner, which often means the total loss of one or more birds from suffocation.

Eighty cubic inches, at least, for mature light-weight varieties and 95 cubic inches for mature heavy-weight varieties should be allowed for the most profitable results.

Sick poultry should not be marketed. It is the shipper who loses when sick birds are shipped, and not the commission-man.

CONCLUSION.

There is no reason why the great figures telling our imports of poultry produce should not be made smaller and our export figures larger from now on.

A better system of standardization must be put into operation in the Province ere long. The only true way to have such a system work successfully is by organization. To have organization successful means the co-operation of all the poultrymen and people interested in poultry-growing throughout the Province.

Much has been accomplished along these lines, but each step must be taken carefully. One must not forget that the market end of the business has to be given consideration as well as the ranch itself.

The proper way to handle poultry. Note the hand holding the primaries and legs to prevent restlessness.

**BULLETINS AT PRESENT AVAILABLE FOR DISTRIBUTION BY THE
DEPARTMENT OF AGRICULTURE.**

No. 7.—Flax.

„ 8.—Feeding Farm Animals.

„ 20.—Varieties of Fruit recommended. (Revised.)

„ 25.—Orchard Cleansing.

„ 26.—Practical Poultry-raising.

„ 28.—Production of Eggs.

„ 29.—Poultry Industry on the Pacific Coast.

„ 30.—Guide to Bee-keeping in British Columbia.

„ 32.—Control of Bovine Tuberculosis in British Columbia.

„ 33.—Fruit-growing Possibilities, Skeena River and Porcher Island Districts.

„ 34.—Fruit-trees and Black-spot Canker.

„ 35.—The Place and Purpose of Family Life.

„ 36.—The Preparation of Food.

„ 37.—The Preservation of Food.

„ 38.—The Construction of Silos.

„ 39.—Natural and Artificial Incubation and Brooding.

„ 40.—Alfalfa.

„ 41.—Labour-saving Devices in Household.

„ 49.—Market Poultry.

Applications for bulletins should be addressed to the Secretary, Department of Agriculture, Victoria, B.C.

ERRATA.—On page 10 the title of cut at top of page should read: “Three grand roasters. The breast and keel bones are well hidden.”

The Department is indebted to “Successful Poultryman,” Vancouver; Cornell University, and Ontario Agricultural College for the use of several of the cuts printed in this bulletin.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.

1913.

PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF AGRICULTURE
(WOMEN'S INSTITUTES)

BULLETIN No. 50

THE ART OF RIGHT LIVING

BY

MISS ALICE RAVENHILL,
Fellow of the Royal Sanitary Institute, etc., etc.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1913.

PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF AGRICULTURE
(WOMEN'S INSTITUTES)

BULLETIN No. 50

THE ART OF RIGHT LIVING

BY

MISS ALICE RAVENHILL,
Fellow of the Royal Sanitary Institute, etc., etc.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.

1913.

DEPARTMENT OF AGRICULTURE,

VICTORIA, B.C., March 8th, 1913.

Hon. Price Ellison,

Minister of Agriculture.

SIR,—I have the honour to transmit herewith Bulletin No. 50 entitled, "The Art of Right Living," compiled by Miss Alice Ravenhill Fellow of the Royal Sanitary Institute, etc., for distribution to the members of the Women's Institutes throughout the Province.

I have the honour to be,

Sir,

Your obedient servant,

WM. E. SCOTT,

Deputy Minister of Agriculture,

Superintendent of Institutes

THE ART OF RIGHT LIVING.

WHAT is our chief object in life? There may possibly be a majority among us who have never paused to consider the question. We have just lived: got up and gone to bed; eaten and drunk; worked and talked; grumbled a bit, perhaps, enjoyed and suffered much and often; but never given a thought to the REASONS WHY we enjoy pleasures or endure pain; much less have we turned our attention to this question: What is the object of our existence?

Of course, it may so happen that a few among us were reared on the Old Scotch Catechism. Then our reply to the inquiry will be prompt and mechanical rather than thoughtful: "The chief end of man is to glorify God and enjoy Him for ever."

But what possible connection is to be found, you will ask, between this concise definition of a Scottish Covenanter's religious faith, our own little-considered ideal of an object in life, and

THE ART OF RIGHT LIVING?

Just this: We consciously or unconsciously glorify God by the standard of our daily lives, not by the singing of a hymn at intervals of a week or longer. Our object in life—our ideal—is or ought to be the maintenance of efficiency in ourselves and our homes, in order that our households may contribute their full share to the progress of the world and the betterment of humanity.

By what means, then, is energy fostered, health promoted, productiveness achieved? The answer to this inquiry is found in the title of this bulletin, which also indicates the connection I desire to trace for you.

RIGHT LIVING SHOULD BE OUR CHIEF OBJECT IN LIFE;

right living is the means by which, through the fullest development of all our powers, we glorify God. But this is not all. The title introduces another thought when it speaks of the art of right living.

WHAT IS AN ART?

If a good dictionary is at hand and you turn up the word "art," you will find it explained somewhat as follows: "Skill, dexterity, tact in planning and carrying out a project; a series of rules designed to aid one in acquiring practical skill or dexterity in performing some specified kind of work."

The full intention of my chosen title should now be clear. Seeing that it must be our object in life to live up to

THE HIGHEST LEVEL OF EFFICIENCY

of which each individual is capable, we must study rules designed to promote our ideal, and must acquire practical skill in their performance.

It is a common saying that there is nothing new under the sun; here is another proof of its truth in connection with our subject. The famous Greek poet, Homer, who lived, it is believed, about three thousand years ago, wrote the following words as a result of his experience of life:—

"IT IS NOT STRENGTH BUT ART OBTAINS THE PRIZE."

That is to say, it is not brute force or endurance which ensure success to men, but skilled dexterity in playing the game, whatever it may be; in this case, the game of life.

Has it never struck you how strange it is that for hundreds of years men have designed and carried out rules for their guidance in commerce, agriculture, forestry, navigation, and military tactics; they have devoted time and money to promoting effective methods in the care of crops and stock, even for the wholesale destruction of human beings; but have given little heed to the protection of their own health and have framed no rules to improve their own race?

The art of right living, as we understand it, took its rise barely a century ago, and it is but slowly assuming its

POSITION OF SUPREME IMPORTANCE

in the civilized world of to-day. Nevertheless, great things have been already achieved by the devoted service of medical officers of health, sanitary engineers, inspectors, and other expert officials. The death-rate has in many cases been halved; in others it has been reduced by two-thirds of what it used to be. The mortality from infectious diseases among young infants is strikingly lowered; the chances of life, and, what is more, of effective life, are correspondingly increased and

THE CONTROL OF ILL-HEALTH

is more and more firmly established, as a knowledge of its causes is obtained. Each year sees sounder information at our disposal as to the marvellous means of self-protection possessed by the human body and of the conditions essential to mental and physical well-being. The distribution of diseased and adulterated food is subjected to penalties of increasing severity; filth is more rapidly and effectively removed from the neighbourhood of our homes, and more supervision is exercised over sources of public water-supply. What more, then, is necessary in order that the multitude of

DISCOMFORTS WHICH HAMPER OUR EFFICIENCY

and weaken our powers shall also be banished from our homes?

Much more co-operation from private individuals is called for, if health is to reach the level it could do if all our knowledge were utilized for this art of right living. Until precepts are translated into practice, they resemble some vast treasure hidden in the depths of the sea, while its owners starve and die for want of the necessities of life.

No life need be lost to-day for lack of knowledge. That so many lives are warped, curtailed, and wretched is due rather to

INDIFFERENCE, APATHY, AND BAD HABITS.

There is urgent need for every household to study the rules of healthy living; for every housekeeper to acquire skill and tact in their practice; for each individual to feel it his business to understand the conditions under which he can do the most and the best work; and then—here comes the pinch, for we are so selfish and indolent and conservative in our habits—comply with them.

It is absolutely possible for each one of us to raise our lives to

SOMETHING HIGHER, MORE HEALTHFUL AND BEAUTIFUL AND ADMIRABLE

than those we have hitherto led. Our work need not so often miscarry, nor be so dull and distasteful. The majority of our daily frets and hindrances are self-inflicted; and no quantity of drugs, no floods of self-pity, can heal or remove them. The remedy lies in the practice of the art of right living, the outlines of

which are mapped out below. The remainder of these pages will be devoted to sketching in some details; to complete the picture would call for many bulletins.

OUTLINE OF THE ART OF RIGHT LIVING.

- (I.) THE PRACTICE OF CLEANLINESS IN

the air breathed,

the water used,

the personal habits,

the surroundings.

External care of

Internal care of

skin,

hair,

teeth,

clothing.

lungs,

digestive tract.
- (II.) INTELLIGENT RULES AND PRACTICE IN REGARD TO DAILY ROUTINE IN

food and drink,

sleep,

work,

exercise,

recreation.
- (III.) BECAUSE OF OUR DUTY TO

self,

home,

neighbours,

Empire,

Race.

A WORD OF CAUTION MAY BE ADVISABLE.

Do not misunderstand me: the maintenance of health does *not* depend upon continuous attention to bodily wants or needs; the result would be a population of nervous invalids; but *upon the formation of healthful habits*, which, when thoroughly ingrained, can be left to take care of themselves and of the body, while the mind is set free to follow out the course of life whatever this may be.

(I.) THE PRACTICE OF CLEANLINESS.

The housewife's life has been described as a perpetual war against dirt. Where does it all come from?

Much of it is the result of the constant grinding or rubbing of one surface against another; wagon-wheels grind dust off the surface of yard or road; boots grind off the surface of their soles as well as of the floors or carpets upon which their wearers walk. The contact of clothes with furniture is the source of more dirt, so is their contact with the skin of their owners.

ALL BURNING OF WOOD, OIL, COAL, OF OTHER FUELS

makes dirt; the steam from the vessels on the kitchen stove carries a cloud of greasy, sugary dirt all over the room. The breath and waste matters excreted by men and animals contribute impurities to the air; all living matter as it passes through countless forms and stages of decay adds its quota of dirt to the atmosphere.

MOST DIRT IS, IN THE FIRST INSTANCE, INVISIBLE;

therefore more difficult to control. When it collects on tiny shreds of cotton or wool; when it settles, several layers thick, in an unoccupied room; when it adheres as "mud" to shoes and clothes; when it smells badly, our attention is attracted, and by its removal we feel some reward for our ceaseless labour in "cleaning"; but to banish invisible as well as visible dirt from our homes demands knowledge of its sources and forms and a very high standard of duty; for invisible dirt is by far the more dangerous to our health.

I do not hesitate to say that were the dirt in the air of our houses visible, there would speedily come about a

VAST IMPROVEMENT IN THE NATIONAL HEALTH;

for we should be sickened by the sight of the foul air we feed to our poor long suffering bodies. The lungs require no less than 2,000 gallons of air to meet the body's needs every twenty-four hours. Perhaps, during that time, we may drink 3 pints of water and eat from 2 to 4 lb. of food. About the cleanliness of this food and water we think a good deal; about the quality of this enormous volume of air we scarcely think at all. So we become

"POORLY," ANAEMIC, DYSPEPTIC, OR PEEVISH;

and suffer from frequent colds, the cause of which we seek in every direction but the right one. Now, listen to the words of a physician of world-wide renown, Professor Leonard Hill, of the London University, on the subject of "Stuffing Rooms": "The changing play of wind, of light, of cold," he says, "stimulates the activity and health of mind and body. Cold is not comfortable, neither

Fig. 1.

To illustrate inexpensive but effective methods of room ventilation.

Reproduced by kind permission of Messrs. E. J. Arnold & Son, Ltd., from "Practical Hygiene," by Alice Ravenhill.

hunger; therefore we are led to ascribe many of our ills to exposure and seek to make ourselves strong by what is termed good living. I maintain that the bracing effect of cold is of supreme importance to health and happiness; that we become soft and flabby and less resistant to the attacks of infecting bacteria in the winter not because of the cold, but *because of our excessive precautions to preserve ourselves from cold*. The prime cause of 'cold' or 'chill' is not really exposure to cold, but to the overheated and confined air of rooms and meeting-places."

There is nothing more fallacious, continues Professor Hill, than the supposition that overcoddling indoors promotes health. All our efforts should be directed, he says, towards preventing the overheating of our houses (60° to 65° Fahr. the correct temperature), and to keeping the air in motion. In overheated dwellings the air, confined between the bodies and clothes of the inmates, is raised almost to blood-heat (99° Fahr.), and becomes saturated with moisture, so that

the ordinary cooling of the body, which is an important function of the skin, is seriously interfered with. A strain is thrown on the whole mechanism of the body, one result of which is that the surfaces of the body covered with mucous membrane (the nostrils and throat, for instance) become dry like the nose of a sick dog. In this condition they become very susceptible to bacterial infection and the defences of the body are all weakened. Hence the susceptibility in stuffy rooms to

CATCH THE BACTERIA OF COLDS AND INFLUENZA.

What can we do to ensure clean air in our homes, if it must be kept moving and not be overheated? How can we ensure clean air, above all in our bedrooms, where more consecutive hours are spent than in any other part of our houses?

SOME SUGGESTIONS FOR THE VENTILATION OF OUR ROOMS.

(1.) Insist upon sash, not casement windows. Keep one or more of these open at the top night and day, except when there is severe frost. Close the windows in chilly weather when dressing and undressing, but have no fear of fresh air when in bed. It is far more healthful to have a hot-water bottle in bed all the year round, and to wear warmer garments during the day, than to live and sleep with shut windows.

(2.) If you have delicate children or if the bed must stand close to the window, put a screen between the sleeper and the open window; or fit a board, 6 inches deep and the same width as the window, under the lower sash. (See Fig. 1) (*a*). The arrows in the illustration show the upward direction taken by the outside air as it enters between the two sashes, of which the result is that it mixes first of all with the warmer air near the ceiling, so that the chill is taken off before it comes in contact with the occupants of the room. This is a simple, inexpensive, and admirable arrangement for sitting-room as well as bedroom windows during the winter.

IF THE WIND SET DEAD UPON THE WINDOW,

tuck a strip of cotton wadding along the opening between the sashes, fresh air will enter all the same, but it will be broken up into a thousand streamlets, instead of rushing in like a flood.

A somewhat similar arrangement for a casement window is suggested at Fig. 1 (*b*). The piece of lumber can be cut to any depth preferred for the screen, over which the air will enter the room; it can be bolted into place at night and removed during the day.

(3.) AIR MUST BE KEPT MOVING IF IT IS TO BE CLEAN.

Now, there can be no movement either in air or water unless there is an outlet for the stream as well as an inlet. It is a serious menace to the health of Canadians that, as a consequence of the method of heating their houses, no provision is made for foul air to escape from their rooms. In Great Britain it is illegal to build any room, however humble, in which, if there be no chimney-flue, some other outlet for air is not provided.

An open fire is a valuable means of ventilation (Fig. 1 (*c*)), and at all times a certain proportion of dirty air finds its way up a chimney. The usual substitute in the Old Country is shown at Fig. 1 (*d*).

AN OPENING IS CUT IN THE WALL CLOSE TO THE CEILING,

about 14 or 16 inches long and from 8 to 10 inches deep. A bit of mosquito-netting is nailed over the opening on the outside to prevent the entrance of insects or birds; and indoors a small "hopper" is fixed over the aperture—i.e., a piece of wood sloped out from the wall by reason of its triangular side pieces—so that there shall be no "down draught."

CLEAN WATER

is as essential to good health as clean air. Care in the provision and protection of public water-supplies has saved millions of valuable lives, for cholera, typhoid fever, and dysentery are deadly diseases carried from one person or place to another by water.

It may be said that in the country, where each household has its own well, these risks do not exist. That is more or less true; though water may travel miles in underground streams and still retain the germs of some disease with which it has been contaminated at a far-distant point. Besides which, impure water or insufficient water for cleansing purposes are responsible for a vast amount of poor health, sore throats, and bodily discomforts. Fig. 2 illustrates a state of affairs all too common in many a farmstead. Leakage (2 (a)) from a privy, cesspool, tank, or manure-heap (2 (b)) finds its way to the well, with

Fig. 2.

Reproduced by kind permission of Messrs. E. J. Arnold & Son, Ltd., from "Practical Hygiene," by Alice Ravenhill.

unsatisfactory results to the consumers of the dirty water. The relative position of well, midden, stable, cow-shed, pigsty, and sanitary convenience is of great moment to the family health. When in doubt as to the cleanliness of water,

BOIL IT FOR AT LEAST HALF AN HOUR.

The "flat" taste can be removed and its pleasant sparkle can be restored by the simple expedient of pouring it two or three times from one jug into another; this restores the air which is driven out by the boiling process.

CLEANLINESS IN PERSONAL HABITS

is a very big subject, which can be touched upon all too briefly in these pages. It must be considered under two heads:—

- (a.) External cleanliness, or care of the person; and
- (b.) Internal cleanliness, which is of equal importance.

(a.) EXTERNAL CLEANLINESS.

This includes care of the skin, nails, hair, and teeth. The story is told of an old Sussex gardener, innocent of bathing, who remarked: "I be quite clean; my sweat cleans me." In one sense he was right. The passage of perspiration through the skin (and at least a pint and a half of water leaves the body through the sweat-glands in twenty-four hours) is a much more cleansing process than the mere throwing of water over the body in a bath. Many physicians advise that every one should, during some part of the day, undergo sufficient active exertion to induce free perspiration. One reason why manual workers are so much more healthy than clerks or servers in shops lies in this fact, that they perspire freely in consequence of the nature of their work; whereas clerks, bar-tenders, and others similarly employed lead sedentary lives in overheated rooms, so that their skins become soft, flabby, and inactive. But even the hardest labour cannot entirely replace a warm bath, in which by the use of soap and friction surface dirt is removed. Preferably this bath should be taken at night, as it is advisable

NOT TO LEAVE THE DAY'S DIRT BETWEEN THE SHEETS!

Few people nowadays seem able to take a cold bath, bracing as it is to those whom it suits; the reasons for this cannot be discussed here owing to the limits of space; neither do they concern our subject, for cold water exercises no cleansing effects.

Perhaps the two points in this connection which most call for emphasis are these: To cleanse the person thoroughly does not demand gallons of water, pleasant though it may be to enjoy the luxury of a deep bath. If water is scarce, stand in a bowl of hot water, and rapidly rub the body all over with a well-soaped loofah, sponge off the soap and dry with a rough towel. The friction cleanses and stimulates the skin, more than the amount of water used; and soap is necessary as well as the hot water, in order to dissolve and remove the greasy deposit on the skin.

Do not be afraid to wash the *hair*! It is a mistaken prejudice which leads people, otherwise clean, to leave the scalp dirty. Is it not a sore disgrace to mothers all over the world, even in the most highly civilized countries, that from 50 to 80 per cent. of the girls medically examined in the public schools should have unclean heads? Heads should be washed every fortnight or three weeks; though the use of strong alkalis to soften the water, such as soda or crude ammonia, or of cheap soap, is inadvisable; rain-water should be used when possible, and a good quality of soap.

Nails are strangely neglected in many cases; yet the rim of dirt beneath a fingernail may carry infection to the food with which the finger comes in contact; while ill-kept nails are not only a disfigurement to their owner, but prevent the same delicacy of touch in the finger-tips, which, next to the lips, are the most sensitive part of the person and indispensable to the execution of skilled work.

CLEANLINESS AND CARE OF THE TEETH

are even more neglected than are the hair and nails; yet it is no exaggeration to say that the owner of one decayed tooth is the subject of slow poisoning; while a whole host of unsuspected ailments more or less serious are the direct result of a mouth full of unhealthy teeth. It is hoped that Fig. 3 will illustrate the truth of these statements. It shows two teeth in the upper jaw, split down lengthways, so that their structure can be seen.

Observe, in the first place, that each tooth consists of three parts:—

- (1.) A crown; that is the portion of the tooth which shows above the gum;
- (2.) A root or roots; that is the portion of the tooth buried in the jaw-bone;
- (3.) The pulp; for the supply of feeling and nourishment.

The crown is covered with enamel, the hardest structure in the human body, composed of lime and gelatine; but the rest of the tooth is covered with a softer substance, called "dentine" or ivory. The pulp consists of nerves and blood-vessels, which enter the tooth from the jaw-bone. Fig. 3 shows in (1) a perfect "bicuspid" tooth; alongside it are two "molar" teeth, both of them in different stages of decay.

THE PROCESS OF DECAY IN TEETH

is the result of particles of starchy foods, such as bread, lodging in the crevices of the teeth, where it favours the multiplication of a certain form of bacteria which swarm even in the healthiest of mouths. The result of their activity is fermentation and the production of an acid which dissolves away part of the enamel. Another kind of bacteria then attack and dissolve the gelatine, so that a hole is formed and the mischief can spread to the sensitive pulp beneath.

IF TAKEN IN TIME,

so that the decayed portion is carefully removed, while the hole is filled with some proper material, the tooth may last for years. If, however, the trouble is neglected and spreads to the pulp, great pain is suffered, the pulp dies, decomposes, and an abscess results, which causes intense suffering, besides the loss of the tooth, which, meanwhile, will probably have infected its companions. All the time, the owner of the diseased tooth will have been swallowing the disgusting discharge from the abscess, which causes all sorts of troubles—constipation, indigestion, “bilious attacks,” tendency to colds, sore throats, etc. The direful results of the collection of particles of food at various points on the surface of teeth is clearly shown in Fig. 4, which illustrates the process of decay in teeth.

TO ALLOW A TOOTH TO DECAY AND THEN HAVE IT OUT

is far too common practice; but, as is demonstrated in Fig. 5, if a tooth is removed from either jaw it throws two teeth out of use in the other jaw, an important fact of which most people are ignorant. This illustration shows a complete set of sound teeth in the mouth of an adult. How many of us possess this valuable aid to health and beauty?

HOW TO PREVENT DECAY.

(1.) Keep the teeth clean and healthy by thoroughly masticating all the food eaten, instead of bolting much of it unchewed. For this purpose include crisp toast, crackers, and raw apples in the daily diet. The custom of eating only pulpy, soft food and the crumbs of bread is bad for the teeth. Therefore, form the habit of

closing each meal with a bit of crisp crust, toast or cracker, or with a raw apple, the juice of an orange, or with a draught of water, to leave the teeth as clean as possible.

(2.) Brush the teeth *always at night*, and advisedly in the morning too, with some precipitated chalk; quite the cheapest and most reliable tooth-powder. To increase its effect, draw the brush once or twice across a cake of "Monkey Brand" soap before dipping it into the chalk.

SALIVA IS STICKY;

it needs a powder to remove it, as it clings to the teeth. Pastes and liquid dentifrices are mostly expensive and useless, for they do not remove this sticky secretion, which glues food particles to the teeth.

(3.) Care of the teeth must include their periodical inspection by a competent dentist; this is one of the best investments against ill-health, and must never be neglected.

Nº4.

DECAY OR CARIES OF THE TEETH. X
CEMENT ON ROOT OF TEETH A

FORMULA OF THE PERMANENT TEETH (ONE SIDE).

2	·	1	·	2	·	3		BOTH SIDES
<hr/>								
2	·	1	·	2	·	3		TOTAL
								= 32

INCISORS. CANINE. PREMOLARS. TRUE MOLARS.

CLEANLINESS IN CLOTHING.

It may seem superfluous to refer to this particular form of cleanliness, especially as it just now happens to be the fashion to wear short dresses out-of-doors, so that the disgusting sight of a long skirt trailing in the dust or mud is rare. Will an enumeration of the constituents of road or street dust suffice to make our women turn a deaf ear to Dame Fashion when next she decrees long skirts to be "the mode"? Particles of hair, wool, cotton from animal and our own clothes; specks of blood, pus, and infectious discharge from cuts, wounds, and sores; expectoration from the mouths of consumptives or from others full of putrid teeth; manure and the droppings of birds and animals. Have I quoted horrors enough for once?

Nº 5.

6th YEAR MOLAR B.

FORMULA OF THE
PERMANENT TEETH
(ONE SIDE)

$$\frac{2 \cdot 1 \cdot 2 \cdot 3}{2 \cdot 1 \cdot 2 \cdot 3} = 32$$

BOTH
SIDES
TOTAL

INCISORS. CANINE. PREMOLARS. TRUE
MOLARS.

THE CLEANLINESS OF WOOLLEN CLOTHES

of or corsets or of well-worn shoes often leave much to be desired. Remember that soapsuds and boiling water are one of our best purifiers, worth gallons of much-vaunted "disinfectants." Remember also the invaluable purifying agents for non-washable things provided for us free by Nature; I refer to the sun and the wind.

THE OBJECTIONABLE ODOUR

of soiled, long-worn garments is unfortunately familiar. A glance at our stockings as we remove them at night gives visible explanation of one cause for this. The white, powdery substance adhering to the inner side of the stockings consists of dead skin, rubbed off the surface of the legs by friction; the same thing happens hourly all over the body. If it is left undisturbed it soon decays, as does all dead matter; and unpleasant is the result to sensitive nostrils! Though that is of small importance compared with results to general health.

Much more could be written on this subject, but it is necessary to pass on to a consideration of what is meant by

(b.) INTERNAL CLEANLINESS.

Brief reference must here again be made to the quality of the air we draw into our lungs. Where this is impure or actually unwholesome, there can be no robust health. Anæmia is one of the commonest results of the constant breathing of stale, bad air, and certainly, where there is a persistent tendency to "catch cold," attention should be directed to the character of the atmosphere where the sufferer spends most of his or her time. The

LOWERED VITALITY

associated with habitual breathing of a poor quality of air predisposes to depression, drunkenness, susceptibility to infection of all kinds, debility, languor, and other miseries. Convincing proof of this fact is afforded by the splendid gain to delicate children of

OPEN-AIR SCHOOLS.

Well fed and well wrapped up, they are out-of-doors in all weathers, and colds and infections cease as if by magic.

There is one form of internal cleanliness, however, which must be dealt with at greater length for it concerns most materially the standard of efficiency we attain in life; I mean

RIGHT CARE OF THE DIGESTIVE TRACT.

Any unhealthy condition of the nose and throat as well as of the teeth results in digestive disturbances. For this, among other reasons, it is so important to attend to "adenoids" in children, and to seek medical advice in cases of *chronic* colds or sore throats, as well as when attacked by some acute form of these troubles. It stands to reason that when constant unwholesome discharge is passing into the stomach there must be interference with the normal process of digestion, while the discharge itself is partially absorbed and slowly poisons the system.

Another fruitful source of indigestion has received attention in more than one previous bulletin—viz., eating food at irregular hours, or food unsuited to the consumer, or food in itself unwholesome. In each case imperfect digestion leads to the formation of unhealthy residues, difficult for the body to dispose of. Internal uncleanness follows, usually combined with what a wise and experienced woman physician has described as

"THE CHIEF PHYSICAL SIN OF WOMEN,"

namely, constipation. What does this imply? Many things; but one of the most serious is the retention in the intestines of decomposing matter, the products of

which are gradually absorbed into the blood-stream, carrying disorder and discomfort all over the body, and reflected in the leaden, spotty complexion, languor, and often foul breath of the sufferer. A mother has few more important duties to perform with her children than the formation, even from birth, of regularity in the discharge of solid waste matters from the body. The earlier a habit is formed,

THE STRONGER AND MORE PERSISTENT IT IS.

Throughout infancy, childhood, and youth nothing must be allowed to interfere with attention to this physical requirement, regularly, at a stated hour.

Probably the regrettable prevalence of constipation among women is due to the indefinite and nondescript character of their duties. A man or lad knows that he must leave the house to start work at a given time and he makes arrangements accordingly; whereas a woman has no such stated hours for her occupations. Her intentions are just as good; but perhaps the children take a little longer than usual to get off to school, or the kitchen fire gives extra trouble, or certain dishes for the midday meal must be prepared early or they will not be ready to time; and so the morning slips away, without attention to her own physical duties. Thus the bad habit creeps ahead, and presently it can only be controlled by the constant resort to drugs, a pernicious and unsatisfactory means of affording relief to the body.

REMEMBER THE WORDS OF A FRENCH DOCTOR:

"If you want to cure yourself of chronic constipation, you *must* cultivate regular habits. Choose a moment which is likely always to be convenient, even though it involves getting up a few minutes earlier to keep to it with punctuality. If the effort to relieve the bowel naturally be unsuccessful one day, put the failure out of the mind for twenty-four hours; then try again at the appointed hour, probably some success will follow." Never allow more than three days to pass, however, without relief. But remember that

THE MORE POWERFUL THE REMEDY USED,

the more obstinate will be the succeeding constipation. It is for this reason that when the addition of more fruit or vegetables to the diet or the drinking of more water (especially a tumblerful at bedtime and in the morning) have failed to relieve the trouble, cascara in some form is often recommended. The dose of this drug can and should be gradually reduced until Nature once more undertakes her own work.

A WORD OF URGENT CAUTION

is necessary on the subject of relieving chronic constipation by the use of injections, a means never permissible except under a doctor's orders. In addition to the many disadvantages associated with the habitual use of this treatment, it must be borne in mind that waste material is removed from the lower bowel only, so that serious accumulations take place in the higher portions which are left unaffected. An occasional dose of rhubarb, just

TO GIVE THE BODY A SPRING CLEAN,

is advantageous; but too strong a protest cannot be uttered against habitual resort to aperient medicine as an aid to internal cleanliness. Such a dose at intervals, however, will often relieve certain periodical discomforts which hamper some women's lives, and which are too liable to drive them to stimulants or narcotic drugs for relief.

It is well worth while to give a periodical dose of rhubarb a good trial; if it does not diminish subsequent discomfort, always consult a doctor. Small beginnings, when neglected, sometimes result in serious endings. No one can afford to fritter away health by permitting the continuance of possibly preventable discomforts, for which a cause always exists.

CLEANLINESS OF ENVIRONMENT.

Some elements which enter prominently into our surroundings have already received attention—namely, the quality of the air we breathe and of the water we drink, as well as the character of the dirt in our homes and the duty of its control by intelligent cleaning. All three of these elements could be profitably discussed at greater length; so also could others now to be enumerated. The fact is, these bulletins can only serve as suggestions to their readers; details on each subject may be gained partly by means of discussion at meetings or of books, or, like Oliver Twist, by “asking for more” bulletins.

THE FREE ADMISSION OF LIGHT,

more especially of sunlight, to our rooms is a powerful agent in good health. Houses should, where possible, be built with a south-east aspect, so that for nine months in the year each room is daily purified by direct sunshine. The most sunny room in the home must be the children's bedroom, for they spend more time in one room than does any member of the household. Admit every ray of sun,

Fig. 6.

except when the little folk are in bed; and never shield the life-giving sun from any room except during the heat of summer. It is your

CHEAPEST CLEANSER AND DISINFECTANT.

Set yourself against dark blinds and folds of curtains over your windows. Please remember that *one-third* of all the light which enters through a window pours in through the top quarter of its area. When, therefore, the upper part of a window is permanently covered by a thick, dark blind, the most valuable portion of the glass is rendered useless.

Notice the light, washable curtains in Fig. 7. They are graceful, suitable, washable, easily handled, and render blinds unnecessary. Observe the position of the bed in this illustration. It has windows near the head and foot, yet is itself out of any draught. These windows face east and south; so that in the winter the sun's rays slant in under the south verandah, and in the summer they pour in through the eastern window before they are too hot for comfort.

TO OBSCURE LIGHT IS TO SEEK ILL-HEALTH.

There can be no real cleanliness in a dark house; dirt, darkness, and disease are inseparable companions. A part of our environment which appeals strongly to us all, and to which some of us are even disposed to devote too much time, is

OUR BED.

Yet what carelessness prevails as to the cleanliness of this bed. The sleeper creeps out from between the clothes in the morning, leaving them much in the position in which they have been through the night. By and by the bed is made. In what does the process consist? Well, I will say, in what it ought to consist, and leave you to decide whether your practice comes up to my precept. When getting out of bed throw back the top coverings and just well loosen them, so that they may cool and dry. Before leaving your room, strip off the under-sheet and

Fig. 7.

blanket, raise the mattress as shown in Fig. 8, and throw open the windows to their fullest possible extent, allowing a full hour to pass before making up the bed again.

WHAT IS MEANT BY DRYING A BED?

Most people understand that a bed is better for cooling, but who among us ever sleeps in a damp bed? Let me remind you that moisture is always leaving the body through the skin, to the amount of at least a pint and a half in twenty-four hours. If eight hours are spent in bed, there must be half a pint of moisture shut up in the bedding; moisture which carries off some impurities from the body; consequently undesirable to retain around us. Therefore, a bed must be aired, dried, and purified by light each day.

ALL THE EXCRETIONS OF THE BODY,

solid or liquid, should be removed with the least delay from our houses. Chamber vessels must be kept covered after use and scalded with soda-water after being emptied. Give them and the covers free exposure daily for an hour or two to light and air.

There is no method of disposal of slop-water so safe and inexpensive as a trench about 6 inches deep and from 15 to 20 feet long, filled with stones, and planted on each side with shrubs, of which the roots absorb the fluid, so that no offence is caused in even the hottest weather.

An earth-closet is the best method known for solid excretions. The earth must be dry and free from stones. A small quantity should be placed at the bottom of the pail after emptying, and a shovelful should be shaken over the contents of the pail after use. The pail should be emptied daily into a 4-inch trench in the kitchen garden, the contents being just covered with earth. After a few days the trench can be dug over and plants of the cabbage tribe should be the first crop raised. The garden will flourish and family health will be maintained where this method is adopted.

IF ANY OFFENCE IS EXPERIENCED,

the cause will be found either in the misuse of the pail or in its too infrequent removal. No liquids must find their way into the pail, and the removal should be daily. In snow or frost the contents can be heaped in an outside shed, with the addition of a sprinkling of dry earth, and removed when the thaw sets in. On no account must the trench be dug more than 4 or 5 inches deep, as the germs which convert this valuable manure into a form suitable for plant-nutrition can only work near the surface; hence a deep trench defeats the end in view.

THE CONTROL OF FLIES

in our environment depends entirely on the proper disposal of refuse, stable manure, vegetable accumulations, and so forth. Never say you cannot imagine why there are so many flies. Their presence is a reflection upon your own cleanliness and that of your family. Banish accumulations of refuse and you cut off your supply of flies. They prefer stable manure for their breeding-grounds, but will make the best of any filth which happens to be at hand! Try and persuade your men-folk to sprinkle a little dry earth over the manure-heap when they clean out the stable, and you will enlist valuable allies in your fight against the fly-plague. Much more could be said on the subject of a healthy environment, but it is now necessary to pass on to the consideration of

(II.) INTELLIGENT RULES AND PRACTICE IN DAILY ROUTINE.

Many people consider routine a deadly, wearisome thing. The general craving to-day is for constant change and variety. Is it advantageous, then, to prescribe a regularity which seems so unacceptable to the modern world?

There is no doubt some benefit in reasonable variety in the conduct of a part of our lives. Mental refreshment is associated with occasional change in the form of recreation or companionship; and physical refreshment usually follows change of air and scene. But a part only of the working of our lives lies under our control; the more mechanical processes of existence are carried on independently of our will and pleasure; as, for example, the act of breathing, the circulation of the blood, and the process of digestion. That is to say,

THE MECHANISM OF LIFE

is beyond our power to govern, but it depends largely for its efficacy upon our daily habits. The machinery of our bodies works with exquisite accuracy if we give it a fair chance; but, if for months we sit for hours by the fire and then suddenly attempt to climb a high mountain, we must not be surprised if this mechanism gets out of order from the unexpected strain put upon it!

If we never go to bed two successive nights at the same hour, can we be surprised if sleep suffer and fatigue handicap our pleasures?

REASONABLE REGULARITY IN BODILY HABITS

should be our rule, if we want to be efficient and healthful. It is unnecessary for me again to enlarge upon the importance of regularity in meals. Punctuality is a

time-saving, health-promoting, virtue, which should be cultivated in youth and fostered throughout life. Make a stern rule that in your house, at least, there shall be no eating or drinking between meals, except, of course, when thirst is excessive in hot weather.

I refer here more particularly not only to the constant eating of candies, but to the injurious results of "nips" of alcoholic drinks at all hours in the day; a habit bound to bring disaster sooner or later, if not to the drinker, without doubt to the offspring. All investigation goes to show that

THE CHILDREN OF ALCOHOLIC PARENTS,

not necessarily of what are usually called "confirmed drunkards," are more susceptible to all forms of nervous disease, less fit for the battle of life, than are those of abstainers. If alcohol must be taken, then let it be drunk at meal-times, not between-whiles; and remember, more than 1 oz. (two tablespoons) a day is harmful. Resort to tea or coffee at odd hours is also to be deprecated in the interests of good health.

REGULARITY IN HOURS OF SLEEP

is of equal importance to health and efficiency, with regularity of meals. This alternation of rest and activity is one of the most strongly marked rhythms in nature. The rest of winter succeeds the activity of summer in the world of vegetable and insect life. Night follows day, the ebb-tide alternates with the flood. The human body is a

MASS OF RHYTHMICAL HABITS.

The temperature rises and falls with absolute regularity when the body is in good health. Muscular energy is regularly greater in the morning, less in the afternoon. Did space permit, examples of these bodily rhythms could be multiplied manifold. The heart, for instance, works and rests in quick alternation, so that it is hard to believe what is the fact, that it rests just as long as it works. But no rhythm is more important or more beneficial to health than that of

THE HABIT OF PROLONGED, QUIET SLEEP.

Experts on the subject of nervous diseases and insanity say without hesitation that sufficient sleep, under suitable conditions, constitutes the best insurance against breakdowns and mental instability. Like all rhythms, sleep must be permitted at regular hours, and experimental observations show that sleep before midnight—

"BEAUTY-SLEEP," AS OUR GRANDMOTHERS CALLED IT—

is far more refreshing than sleep, however sound, after midnight. This is a strong argument against late hours for adults as well as for children. There can be no sound, vigorous population when the hour for retiring is habitually midnight or later.

WHAT AMOUNT OF SLEEP IS NECESSARY?

This is a question impossible of direct answer. Children can scarcely sleep too long. (A table showing the length of hours advisable at each year of age will appear in the bulletin on "The Care of Children.") In later life the number of hours desirable depend upon the individual and the character of the work done.

Some people do well on six hours' sleep, for others seven hours suffice, while most women find eight hours none too much for their refreshment. No hard-and-fast rule can be laid down, except that in every case more sleep is needed in winter than in summer, owing to the lowered vitality consequent upon absence of bright light and sun-heat.

WHAT ARE THE MOST SUITABLE CONDITIONS FOR SLEEP?

To this inquiry a most definite reply can be given. Refreshing sleep demands quiet, darkness, pure air, warmth, and comfort. We need sleep because all activity

causes fatigue. Fatigue is caused by the presence in the blood of certain poisonous matters which result from activity, especially from muscular activity. Hence manual labourers usually need longer hours of sleep than brain-workers, for only during sleep are these matters cleared out by the body.

Rest without sleep does not suffice to remove fatigue, and the fallacy that

CHANGE OF OCCUPATION IS REST

has cost many overworked people very dear.

Quiet is essential to refreshing sleep, because any noise, even though the sleeper may not hear it consciously, stimulates the brain.

Light, too, is a stimulus, and interferes with complete repose. People who live near a trunk or car line or in some crowded city constantly wake in the morning feeling almost as weary as when they went to bed, because the repairing process, so active during sleep, has been interrupted by recurring noises or flashing lights.

Pure air is another essential to recuperative sleep. Only in the coldest weather should the bedroom windows be closed; have them open to their fullest extent if you desire good health; and sleep on the porch, if possible, six months out of twelve.

Warmth is indispensable to good sleep. Don't overload the bed with heavy quilts or "comforters"; a hot-water bottle is far more wholesome, and its contents are conveniently at hand for toilet purposes in the morning.

Down coverlets, when ventilated, are delightful bed-coverings. It can be hardly necessary, in the twentieth century, to caution against the use of feather beds. They are in every way unwholesome, enervating, impossible to "air" properly, and perfect carriers of infection.

Reasonable comfort is most generally provided by modern bedrooms. Knobbly "flock" mattresses are comparatively rare, having been replaced by purified wool or, better still, by horsehair. Where the expense of wool or hair cannot be afforded, a bed filled with chaff, which is so cheap it can be easily renewed at intervals, is much to be preferred to "flocks," which are too often made from filthy and imperfectly purified rags and shreds of old cloth clothes. Active measures to prevent the further manufacture of this form of cheap but most insanitary bedding have been taken in the Old Country, as the result of the exposures published by the indefatigable Chief Sanitary Inspector of Glasgow, Mr. Peter Fyfe.

THE HYGIENE OF DAILY WORK

in factories and workshops has now received attention for a hundred years, although much still remains to be done to secure entire satisfactory conditions for workers; in many cases, on account of their own indifference to the subject.

But the provision of ideal conditions for the performance of domestic duties has lagged far behind; women continue to estimate the worth of their service by the fatigue experienced, and pride themselves, not upon their intelligent adoption of improved appliances as they come on the market, but upon their ability to produce good results at an extravagant expenditure of time and energy, without employing conveniences to be purchased for a few cents or, at most, a few dollars.

SUCH CONDUCT IS UNINTELLIGENT AND BLAMEWORTHY.

Naturally, each woman has her own particular problems and must study the conditions of her own duties in order to decide where a saving of energy can be legitimately effected, and in which direction "steps can be saved" to the greatest advantage.

WORK IS BENEFICIAL WHEN PROPERLY PERFORMED.

Without exercise muscles soon become flabby, and flabby muscles are associated with all sorts of physical discomforts, besides a passing stiffness when called upon to exert themselves. Far more injurious than flabby muscles, however, is a flabby brain. Nerves deteriorate for want of exercise more rapidly even than muscles.

WORK CEASES TO BE DRUDGERY WHEN CONSCIOUSLY DIRECTED BY AN ACTIVE BRAIN.

No more profitable subject can engage the attention of the members of women's institutes, congresses, or clubs than the more intelligent utilization of activity and appliances in daily domestic routine. Call in the aid of men, for they have long grasped the value of right posture, appropriate tools, and well-considered surroundings as aids to effective, economical work. Impress upon young people that

POWER TO DO GOOD WORK IS A PRIVILEGE.

The utilization of the labour-saving devices described in Bulletin 41, and their supplement by others as they are introduced, will so lighten the call upon strength that energy will remain for other forms of exercise, of importance to mental as well as physical well-being. Have you ever noticed the change in your feelings of anxiety, fret, or irritation before and after a short, brisk walk with a pleasant object or in the company of an agreeable friend?

The blood has circulated more rapidly and promoted more effective nutrition; the brain is also stimulated by a purer blood-supply, so that life has assumed a much brighter aspect. Quickened respiration has increased vitality and given a fillip to the body's furnace, so that waste matters are more completely destroyed and nutrition is more perfect. Muscles unexercised by domestic duties are brought into play, while those wearied with work are given a respite from activity. A short, sharp walk should constitute a daily tonic. It is cheap, beneficial, and exhilarating.

BY YOUR OWN WELL-BEING ENTHUSE YOUNG PEOPLE WITH THE JOY OF WORK AND SERVICE.

May not some of the prevalent distaste for family service be due to its association with an overwrought, preoccupied woman, always tired, sometimes indifferent to her appearance or figure? Instil from early days respect for the body, the dignity of ministering to its needs, the skill involved in the right care of human life, the joy in lightening the burdens of others, the privilege of utilizing ability to do anything just as well as it can be done, i.e., the *exercise* of mind and body in well-doing.

THE PLACE OF RECREATION

In busy lives must not be overlooked in any code of health rules. Have you ever observed the economy associated with the possession of two instead of one pair of boots or shoes, so that each pair is worn alternate days instead of continuously? They much outlast the lives of two pairs worn in succession, while the feet they clothe are less wearied.

This is but another illustration of Nature's law of rhythm, about which I have already written. Rest appears beneficial even to inanimate objects, such as boots and shoes; much more is this the case with human beings. Now, though the old idea that change of occupation is rest can no longer be supported, nevertheless change of occupation in many cases means recreation.

RECREATION IS ASSOCIATED WITH LIGHTENED RESPONSIBILITY,

which is one reason why it is so hard for a house-mother to find a place for it in her busy and responsible life. A man comes in with his day's work done, sits down in a comfortable chair to read the paper, or goes out to meet his cronies and smoke a friendly pipe. But his wife has the supper to cook, or the children to bathe and put to bed, or the week's mending to do, or some clothes to make, or the ironing to finish. When is her recreation-time to be found? The appearance of thousands of women give the answer. They never find time to recreate their minds and bodies, so they lose touch with much that fills life with interest and pleasure and age prematurely.

Others there are, found more often among the younger generation, who will not forego the excitements and variety which entered largely into their lives before

marriage, so they just scramble through their home duties and let things "take their chance." In neither case are homes really happy, though in the former they are well kept; in the latter they are not.

REASONABLE RECREATION IS A DUTY TO SELF AND FAMILY.

Make a rule that one hour out of the twenty-four shall be entirely given up to this process of restoring the powers and preserving your elasticity and efficiency. One day the best form of recreation may be an hour on your bed. Another day it may be a chat with a friend; another day it may be found in a book or newspaper; or in retrimming a hat; or in tending a garden-plot; or in a game with the children; or in making a sketch or picking out a melody on the piano.

VARY THE FORM OF YOUR RECREATION,

but never omit the duty of finding time for it. Women are so apt to forget that duty to self as well as duty to family is an element in healthful efficiency. Besides this personal aspect, bear another point in mind. If you want to influence your young people through the most critical years of their lives (from fourteen to twenty-four), you must show yourself able to enter into their pleasures, and to share more or less in their hobbies and pursuits; to discuss with them topics of the day or their favourite books, to be their comrade as well as their parent or guardian. Perhaps this argument in favour of recreation will appeal to you more strongly than the purely personal reasons given above.

I am strongly of opinion that one cause for the still prevalent contempt for domestic duties and growing indifference to the claims of home and family may be traced to the accepted idea that a woman's work is never done (whereas in all other occupations there are stated hours of employment), and the fact that if a house-mother "does her duty" she is cut off from social life; while the mother herself is too apt to consider an overfatigued existence to be her appointed lot in life and not to give sufficient thought to its possible alleviation.

TOO BUSY TO SHARE IN HER CHILDREN'S AMUSEMENTS,

she gets out of touch with their tastes, and they seek sympathy and companionship elsewhere. Do not lose sight of this fact: Rest from work and suited recreation means a direct saving of the vital powers and a consequent prolongation of productive and useful working-days.

(III.) WHY IT IS OUR DUTY TO PRACTISE THE ART OF RIGHT LIVING.

- (1.) Because we owe a duty to ourselves.
- (2.) Because we owe a duty to our homes.
- (3.) Because we owe a duty to our neighbours.
- (4.) Because we owe a duty to our Empire.
- (5.) Because we owe a duty to the Race.

Life is designed to yield results; man is not framed to be a mere cumberer of the ground. The root of efficient life lies in the home. As is the home so is the product.

THE BALANCE OF THE BODY

hangs on the quality of the nature it inherits from its ancestors and the surroundings in which it lives.

The researches of the last few years have brought ample confirmation of the teaching of Moses: the sins of the fathers are visited upon the children to the third and fourth generations.

The children now being reared in our homes are the parents of the next generation. According to our care of their bodies, according to the use we train them to make of their will-power, according to the ideals we set before them, will they be prepared to hand on the torch of human life burning with greater brilliance and

a purer light than they themselves received it; or—surely it is unnecessary to detail the possibilities of deterioration and its gruesome results to offspring. They are but too familiar.

THE CHARACTER OF OUR FOOD, SHELTER, AND SANITATION

are mainly under our personal control; but co-operation with the community around us is necessary for the betterment of the laws and of the general attitude concerning the protection of food-supplies, conditions of labour, building regulations, control of infectious diseases, and other factors in the promotion of health.

“OF WHAT USE IS AN EMPIRE,” ASKED LORD ROSEBERY, “WITHOUT AN IMPERIAL RACE?”

An Imperial race can be assured if all the knowledge now at our disposal be applied to the control of our environment and to the intelligent adaptation of habits to climate, occupation, personal requirements, and social obligations. We are no longer at the mercy of conditions; it is for us to master them and shape them to our own purpose.

It has been well said, and the saying is peculiarly applicable to women's work in our home. “The art of to-day is the beautifying of human lives.” It is my earnest hope that the contents of this bulletin will place at your disposal a part, at least, of the materials necessary for this noble work. Do not forget duty to self as well as duty to others; example outweighs precept any day.

See to it, then, that—

The mind's sweetness shall have its operation
Upon thy body, clothes, and habitation.

For faith without works is dead.

ALICE RAVENHILL,

*Fellow of the Royal Sanitary Institute; Certificated Lecturer
National Health Society, Great Britain and Ireland.
Author of “Practical Hygiene for Use in Schools”;
“Elements of Sanitary Law”; “Some Characteristics
and Requirements of Childhood”; “Household Admin-
istration”; “Household Foes,” etc.
Late Lecturer on Hygiene, University of London, King's
College for Women.*

NOTICE.

The Department of Agriculture is issuing the following series of bulletins prepared by Miss Alice Ravenhill, Shawnigan Lake, B.C., to be available for distribution among the members of the Women's Institutes throughout the Province:—

- No. 1. The Place and Purpose of Family Life.
- „ 2. The Preparation of Food.
- „ 3. The Preservation of Food.
- „ 4. Labour-saving Devices in the Household.
- „ 5. Food and Diet—Parts I. and II.
- „ 6. The Art of Right Living.
- „ 7. The Care of Children.

BULLETINS ISSUED BY THE DEPARTMENT OF AGRICULTURE.

- No 7. Flax.
- „ 8. Feeding Farm Animals.
- „ 20. Varieties of Fruit Recommended. (Revised.)
- „ 25. Orchard Cleansing.
- „ 28. Production of Eggs.
- „ 29. Poultry Industry on the Pacific Coast.
- „ 30. Guide to Bee-keeping in British Columbia.
- „ 32. Control of Bovine Tuberculosis in British Columbia.
- „ 33. Fruit-growing Possibilities, Skeena River and Porcher Island Districts.
- „ 34. Fruit-trees and Black-spot Canker.
- „ 35. The Place and Purpose of Family Life.
- „ 36. The Preparation of Food.
- „ 37. The Preservation of Food.
- „ 38. The Construction of Silos.
- „ 39. Natural and Artificial Incubation and Brooding.
- „ 40. Alfalfa.
- „ 41. Labour-saving Devices in the Household.
- „ 42. Apiculture in British Columbia.
- „ 43. Women's Work in British Columbia.
- „ 44. Irrigation in British Columbia.
- „ 45. Agricultural Statistics, 1911.
- „ 46. Food and Diet—Part I.
- „ 47. Food and Diet—Part II.
- „ 50. The Art of Right Living.

Applications for bulletins published by the Department of Agriculture should be addressed to the Secretary, Department of Agriculture, Victoria, B.C.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1913.

W 461401
LIBRARY
OF THE
COLLEGE OF
AGRICULTURE

DEPARTMENT OF AGRICULTURE.

PROVINCE OF BRITISH COLUMBIA.

BULLETIN No. 51.

INFORMATION FOR FRUIT-GROWERS

WITH

LIST OF VARIETIES FOR COMMERCIAL AND
HOME PLANTING.

BY

R. M. WINSLOW, B.S.A., Provincial Horticulturist.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1913.

BUREAU OF ENTOMOLOGY
RECEIVED
LIBRARY
OF THE
COLLEGE OF
AGRICULTURE
U.S. DEPARTMENT OF AGRICULTURE

DEPARTMENT OF AGRICULTURE.

PROVINCE OF BRITISH COLUMBIA.

BULLETIN No. 51.

INFORMATION FOR FRUIT-GROWERS

WITH

LIST OF VARIETIES FOR COMMERCIAL AND
HOME PLANTING.

BY

R. M. WINSLOW, B.S. A., Provincial Horticulturist.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1913.

TABLE OF CONTENTS.

	PAGE.
Introduction	7
Sources of Information	7
Factors Influencing Choice of Varieties—	
(1.) The Growing Season	10
(2.) Winter Climate	11
(3.) Altitude	12
(4.) The Orchard-site	12
(5.) Fruit-growing Soils	13
(6.) Types of Soils	13
(7.) The Pollination Problem	14
(8.) Variety Characteristics	15
(9.) Prospective Production	15
(10.) How many Varieties to plant	16
(11.) Transportation Facilities	16
(12.) Markets	17
Comments on using Lists	20
List of Districts—	
(1.) Vancouver Island—South-east Section	21
(2.) Vancouver Island—West Coast	23
(3.) Mainland Coast	24
(4.) Northern Coast Valleys	25
(5.) Lower Mainland	26
(6.) Lytton, Lillooet, Spence's Bridge	29
(7.) Kamloops-Walhachin	30
(8.) Southern Central Plateau	31
(9.) Shuswap Lake	33
(10.) Upper Okanagan Lake	34
(11.) Lower Okanagan Lake	38
(12.) Similkameen Valley	42
(13.) Kettle River Valley	44
(14.) West Kootenay	47
(15.) East Kootenay	49
(16.) Central British Columbia	51
General Suggestions to Orchard-planters	52
Map showing Districts	At end

Under each district heading there are discussed the main facts concerning its climate, altitude, area, soils, present production, prospective production, types of fruit most suitable, transportation facilities, markets, and other considerations affecting its development. It has been beyond the scope of this bulletin to go into these in great detail, but the Department is at the service of any intending fruit-grower who desires further information that will guide him in the choice of varieties or the planting and care of his orchard.

DEPARTMENT OF AGRICULTURE,
VICTORIA, June 18th, 1913.

Hon. Price Ellison,
Minister of Finance and Agriculture,
Victoria, B.C.

SIR,—I have the honour to transmit herewith Bulletin No. 51, entitled "Information for Fruit-growers, with List of Varieties for Commercial and Home Planting," compiled by R. M. Winslow, B.S.A., Provincial Horticulturist.

It is hoped that this bulletin may prove of service to fruit-growers in this Province, in giving information as to those varieties which have best proved their adaptability in the different districts for commercial orchards. The information contained therein is compiled from a variety of sources—from observations made by our Assistant Horticulturists, from information supplied by fruit-growing associations and leading orchardists throughout the Province—and may well be taken as representing the consensus of opinion as to the best and most successful varieties of fruits in the different fruit-producing centres.

I have the honour to be,

Sir,

Your obedient servant,

WM. E. SCOTT,
Deputy Minister.

INFORMATION FOR FRUIT-GROWERS

WITH

LIST OF VARIETIES RECOMMENDED FOR PLANTING BY THE PROVINCIAL DEPARTMENT OF AGRICULTURE.

(As revised November 15th, 1912.)

By R. M. WINSLOW, B.S.A., PROVINCIAL HORTICULTURIST.

INTRODUCTION.

IN issuing a revised edition of the "Varieties List," the Department of Agriculture has several objects in view:—

- (1.) To provide definite information as to the best varieties of fruit to plant, both for commercial purposes and for home orchards:
- (2.) To enable fruit-growers of each district to take action so as to limit the choice of varieties for future planting:
- (3.) To assist the nurserymen of the Province to better estimate the probable demand:
- (4.) To discourage extensive planting of new or little-tried kinds:
- (5.) To encourage the working-over of poor or indifferent varieties with scions or buds of those which are more valuable.

This revision has been necessitated by the additional information acquired since the last issue, as to the commercial suitability of varieties, taking into consideration all that has been learned about their commercial suitability, their adaptations to various soils, success in different districts, immunity to fungous diseases, etc.

The marketing question has been made a real problem by the recent increased production in the United States and Canada generally, and in the North-western States especially. The general range of prices received in 1910-1912 has been somewhat lower than in the period 1905-1909, in some instances very much lower. At the same time, there has been a steady increase in the cost of labour and of living. These two circumstances—a using cost of production, and a lower selling price—make it imperative that more care be taken to select the most suitable varieties, and to plant them under the most suitable conditions.

Variety lists were issued by the Provincial Board of Horticulture in 1908 and 1910.

SOURCES OF INFORMATION.

In the compilation of this list a great many sources of information have been drawn upon. First of all, there has been the experience of the members of the Board of Horticulture, which, as the fruit-growers of the Province are aware, is composed of practical fruit-growers, representing the principal districts—men who are in an especially good position to know what is best.

The advice of other prominent fruit-growers and of fruit-shippers throughout the Province has also been drawn on to a large extent, and the Department of Agriculture and the intending fruit-grower owe much to them.

The staff of the Horticultural Branch of the Department, as designated elsewhere in this bulletin, has been called on for information. These men, by virtue of their continual observation in the orchards, in the fruit fairs of the Province, and

in the packing-houses, together with the many discussions which they are able to have, both at meetings and privately, with orchard-owners, are in a position to render especially valuable opinions.

The Markets Commissioner, stationed in the Prairie Provinces by the Provincial Department of Agriculture, to study conditions under which our fruit is marketed and the competition which it must meet, has also advised on the marketability of the various varieties—a most important point.

FRUIT-GROWERS' ASSOCIATIONS HAVE ASSISTED.

In this past year, the British Columbia Fruit-growers' Association has also taken considerable interest in the variety question. At the last annual meeting of this Association, held in January, 1912, a resolution was passed, and it, together with the discussion on it, is reproduced herewith:—

“Moved by B. McDonald, seconded by D. H. Watson, ‘Whereas the shipping associations of British Columbia consider it of great benefit to the fruit-growers to confine their planting to fewer commercial varieties more suitable to their districts: Be it *Resolved*, That the Association ask the various affiliated associations to recommend lists of varieties for commercial planting in their respective districts to the Board of Horticulture for the 1912 revision of the lists of varieties recommended.’

“Mr. McDonald: In speaking to that resolution, I think every fruit-grower of British Columbia realizes the great importance of getting our planted varieties down to the required number. I would instance Hood River as an example of what I mean, and I think the sooner British Columbia fruit-growers do the same thing, the sooner will they achieve the success they are after.

“Mr. Watson: I do not think the question requires much argument. Just consider Watsonville and Hood River. I think it is up to British Columbia fruit-growers to adopt the same principle.

“Mr. Bulman: I thoroughly endorse the idea of the resolution, and I think that the investigations of Mr. Winslow in this direction are to be commended, and I would like to see them extended.

“Mr. Maxwell Smith: I may say that never a week passes but I am asked by some new-comer what are the best varieties to plant, and I think that a list such as is proposed would meet a long-felt want.

“The resolution carried unanimously.”

In compliance with this resolution, the various affiliated associations of the Province gave considerable study to the question of varieties for their respective districts, and their recommendations are incorporated in the list of varieties given.

DEPARTMENT HAS INVESTIGATED HISTORY OF VARIETIES.

The Department of Agriculture, in drawing on the sources of information indicated above, will be seen to have done practically everything possible to secure what experience could tell as to the conduct of the different varieties of fruit. Owing, however, to the very rapid development of our fruit industry in the newer districts, and to the fact that even in our older districts the industry is still very young, there are very many gaps, for which experience and experiment on the ground cannot as yet supply the exact information, and it has been both advisable and necessary to make some investigation of the requirements under which various varieties of fruit reach their greatest perfection elsewhere.

It is a well-recognized fact that each variety of fruit requires a certain type of growing season to reach its greatest commercial perfection, and to approach reasonably to this ideal the growing season must be nearly like that which it has been found to be most desired. Drawing on the records of the meteorological stations of this Province and of Ontario, Nova Scotia, and the North-western States has enabled us to study those conditions under which the different varieties seem to succeed best. Many varieties of all kinds of fruits were found to be adapted to a very limited range of climate, such as the Spitzenberg, Winesap, and Pewaukee apples, the French prune, the d'Anjou pear, the Foster peach, and the Olivet cherry;

while, on the other hand, there are varieties, such as the Wealthy, Wagener, and Ben Davis apples, the Bartlett pear, the Elberta peach, and Pond's Seedling plum, thriving over such wide areas as to well deserve the term "cosmopolitan," as against the "sectional" character of the great majority. The demonstrated success or failure of many varieties in parts of our own Province has strikingly confirmed our expectations based on their behaviour in similar climates. This method of studying climatic conditions and varieties has led to some interesting and valuable suggestions which we are following out in distributing varieties of trees for experimental purposes in our new and untried districts. What is more important, we have been able to verify the wisdom of choice in the case of certain largely planted kinds. It was learned that the principal features of the growing season are:—

- (1.) Its length:
- (2.) The total number of heat units received:
- (3.) The mean temperature of the hottest six weeks.

These are all to be derived by a calculation of records of the daily maximum and minimum temperatures along the lines laid down by the United States Department of Agriculture's Biological Survey. For example, choosing the section in which the Winesap apple reaches its greatest perfection, we find that it requires a growing season of 225 days, with a total of 13,400 heat units, and a temperature for the hottest six weeks of the growing season averaging 72° Fahr. Under such conditions the Winesap bears heavily, produces fruit of the desired commercial size, and of very high colour. Where the season is shorter or less warm, the fruit lacks in size, colour, and dessert quality, in proportion as the season falls short of these requirements. We find only a few districts in British Columbia approaching these conditions. The records for Kamloops show that the Thompson River Valley has an average of 214 growing days, 12,683 heat units, and a temperature in the hottest six weeks of 69.30° Fahr. The Similkameen Valley, of which we have unfortunately no records, we believe to be even more nearly suitable, and this is verified by the fact that Winesap trees in that section are producing heavy crops of fruit of good size and colour. In no other part of the Province of which we have record do we find conditions under which the Winesap is likely to reach the desired perfection. This variety, owing to its great favour in Prairie and Coast markets, is being planted to an undesirable extent in many districts where it may not do very well; and intending planters should bear the above facts in mind. The laws of nature are inexorable; and the attempt to grow varieties in unsuitable districts cannot be attended with success.

The McIntosh Red apple is produced to greatest perfection in districts with about 200 growing days, 11,400 heat units, and a temperature in the hottest six weeks of 65.5° Fahr. Our investigations show that Vernon has 199 growing days, 11,423 heat units, and 66.5° Fahr. as the average temperature of the hottest six weeks. It will be seen that Vernon approaches the ideal very closely. Kelowna, with 201 growing days, 11,507 heat units, and 66.0° Fahr. as the average temperature of its hottest six weeks, is also very nearly ideal for this variety. The summer temperature in both cases being a little on the warm side, the keeping quality of the fruit is not quite as good as it might be.

Turning to Nelson, we find there an average of 202 days in the growing season, 11,427 heat units, and an average six weeks' summer temperature of 65.0 degrees. We would expect that, with this lower summer temperature and a slightly longer growing season, the keeping quality would be better. The greater humidity at Nelson, which we find, when we turn to the records of precipitation, induces the apple-fungus, known as scab, which is a qualifying factor in this instance.

Turning to Victoria, we find this section to have 271 growing days, 14,400 heat units, and a temperature of 60.8 degrees in the six hottest weeks; obviously, in every respect the climate is not a suitable one for the McIntosh Red.

Similar investigations enable us to verify the results of experimental observation with respect to many of our varieties, which gives us confidence in the results of this method of investigation. The methods by which the figures are derived,

and by which the suitabilities of the district are judged, are much too intricate to be dealt with here. The examples will serve, however, to show that the investigation has gone into the question much more deeply than can commonly be done. There can be no question as to the essential accuracy of the deductions, but until the material collected on the subject can be published, only the conclusions as embodied in the variety list herewith can be submitted at this time.

FACTORS INFLUENCING CHOICE OF VARIETIES.

(1.) THE GROWING SEASON.

The character of the season of growth is undoubtedly the most important factor of all those connected with the choice of a variety. The "growing season" is really the summer climate of the district, and it is well known that the summer climate of different districts may vary a great deal, not only in length, but in temperature, amount of sunshine, amount of rain, wind, etc.

In the choice of varieties the length of the growing season is important, because many varieties otherwise entirely suitable cannot reach maturity in an insufficiently long season, such as is often found in a high altitude, though even on the same altitudes different districts show great variation.

The Yellow Transparent, Duchess, and other early apples thrive in seasons so short that the Northern Spy, Jonathan, and other varieties cannot possibly reach proper maturity. It is practically useless to plant the late winter varieties, except a very few unusual kinds, in those sections where the growing season is under 180 days. On the other hand, in the sections of longer growing season, combined with high summer temperatures, the early varieties become very early indeed, and very perishable. In seasons shorter and cooler the fall varieties may become winter keepers.

The temperature of the growing season is of almost as much importance as its duration, and the two naturally go together. Such varieties as the Winesap will not mature properly in a season, no matter how long, unless the summer temperature is sufficiently high; while other varieties, such as the Blenheim Orange, King, Ribston Pippin, require a reasonably long growing season, but it must also be reasonably cool, high summer temperatures injuring their keeping quality and also their flavour.

The relation of sunshine to varieties is also of importance. On the Coast, the months of September and October are usually hazy, and while the sun may be visible, the sunshine is not strong. Under these conditions, many sun-loving varieties, such as Jonathan and Spy, refuse to colour up well, while others, especially those varieties of English origin, gain their usual colour.

The humidity of the air, while a factor which is not readily susceptible to observation, has a great deal of influence on the choice of varieties. Where the air carries a high percentage of moisture many fungous diseases thrive, and in consequence those varieties of apples which are susceptible to such diseases should be avoided. It is on this account that the Snow apple, so subject to apple-scab, is usually badly deformed in Coast regions, and the Flemish Beauty pear is practically impossible to grow in these sections on that account. For such sections varieties originally propagated and developed under similar conditions are most likely to be resistant, and to bear clean fruit.

In other districts, such as the humid sections of the Interior, the relative humidity is not so great as on the Coast, and it is quite possible, by reasonable care in pruning and spraying, to grow susceptible varieties with very satisfactory success. In the Dry Belt, where the humidity is naturally low, and evaporation therefore greater, the skin of the apple becomes thicker and stronger, making it more adaptable for shipping. In this climate fungous diseases are almost unknown, and this factor need not be considered in the choice of varieties. On the other hand, some physiological troubles seem to thrive most readily in the non-humid sections, and varieties susceptible to them should be avoided. In this section, too, those varieties

which thrive best under irrigation methods should be chosen. There are some varieties which do best under irrigation; others require humid conditions; others have no preference.

The total precipitation, including both rain and snow, is the principal factor in determining whether irrigation will be necessary or advisable. In regions of excessive precipitation drainage is necessary for practically all varieties of apples, but there are some few kinds which seem to do much better than the average in low or otherwise wet locations, such as Ben Davis and Golden Russet.

The months of greatest precipitation are also of importance. Some districts receive their precipitation principally in the winter-time, and there is in consequence not enough moisture in the summer-time, without irrigation, to bring many varieties of apples to commercial size, while other varieties, such as Duchess, Alexander, Wolf River, and King, will grow quite large enough.

In those districts which have a limited summer precipitation without irrigation-water available, such early maturing fruits as strawberries, cherries, and early plums will succeed commercially, where longer season fruits, such as winter apples, would be unsatisfactory.

It is because of the lack of summer moisture in Victoria that raspberries do not succeed as well as strawberries, and similarly in the Lower Mainland, where the moisture-supply continues later into June, raspberries are more successful, while the strawberries are softened by the rain.

Heavy rains in the blossoming season are injurious to fruit setting, and are undesirable. Heavy precipitation in May and June lends itself to fungous diseases, while heavy precipitation in September and October, such as is found in some districts, materially interferes with the keeping quality of apples, their colour and maturity. This question of the seasonal precipitation is a most important one in the commercial production of fruit.

Wind, or the absence of wind, is in some cases an important consideration. The valley winds, characteristic of many sections near mountain-ranges, materially help to prevent frost, but heavy winds cause injury by bruising cherries and other soft fruits, and by causing apples to fall. Persistent winds from one direction made tree-pruning a difficult matter, and wind-breaks may be essential to the success of an orchard in such cases.

Late spring and early fall frosts are material factors in choosing varieties of fruit. In a section where late spring frosts are likely to occur, it is not advisable to attempt peaches, Japanese plums, or cherries on a large scale, while walnuts, apricots, and almonds require unusual freedom from late frosts. Early frosts in the fall, if not too severe, are of material value in increasing the colour of late apples, though extremely heavy early frosts are liable to damage nearly all kinds of fruit, not excepting the hardest of winter apples.

Hail is not unknown in the Interior of British Columbia, and may cause some loss, but its occurrence is so rare that it effects no material damage, as in some parts of France, where it is the cause of great loss to the grape-growing industry.

Cloudiness, fog, and haze, which are more or less likely to occur on the Coast, have an undesirable effect on many kinds of fruit; and on this account, locations which, because of altitude, exposure to the south, and prevailing winds, or other reasons, are most free from these, are likely to produce the best fruit.

(2.) RELATION OF WINTER CLIMATE TO THE CHOICE OF VARIETIES.

The average snowfall is reasonably constant throughout each district of British Columbia, and may be reckoned with as such. In those sections where snowfall is very heavy, amounting to 3 or 4 feet on the level, it is more desirable to have varieties of trees which do not break down under the weight of snow. This can be overcome to a considerable extent by proper methods of pruning, but not successfully by high heading, as is sometimes attempted. In all Interior sections where winter temperatures may drop low, it is most desirable to have some snow covering to protect the soil and to prevent root-freezing. In the irrigated districts the melting snow supplies moisture for the early spring months, and where it is a fairly constant

factor, as at Vernon, irrigation is not necessary as early as where snowfall is much lighter, as in the southern end of the Okanagan Valley. On the Coast snowfall is rare, though some sections, particularly in proximity to the mountain-ranges, have more or less.

The minimum winter temperature is one of the principal determining factors in choosing varieties of fruit, especially in the Interior. In the Coast regions, where zero temperatures are rarely encountered, practically all the varieties of the temperate regions can be grown, as far as this factor is concerned, with equal success; but in the Interior it is very necessary that varieties be chosen which are likely to stand the minimum winter temperature without damage. The blossom-buds of practically all varieties of peaches are frozen by a temperature of 14 or 15 degrees below zero, and, in consequence, peaches are successful only in a limited number of areas. The buds of cherries, especially some sweet varieties, suffer at slightly lower temperatures, while the tenderer apples, such as Newtown, Spitzenberg, and Cox's Orange, are apparently injured at around - 25 degrees. The McIntosh and Wealthy stand as low temperatures as are experienced in any of our old fruit districts without injury to either wood or fruit-bud. In more northerly or higher sections, even harder kinds must be used.

In the variety list submitted, the question of winter injury has been given almost first consideration, and the varieties given may be counted on to stand practically free from winter injury. In some of our principal fruit-producing sections, winter injury of tender varieties has been the cause of greater loss than all other factors combined, but experiment has proceeded so far that this factor becomes almost negligible in the planting of new kinds.

The duration of periods of low temperature, and the amount of wind with which they are accompanied, should be considered with absolute minimum temperatures in considering the effects of freezing, as the duration of the freeze and the amount of wind aid materially in causing injury.

The humidity of the air in winter is a great factor in the amount of injury caused by freezing. The greater the humidity, the less injury is caused. This factor has, however, been also considered in recommending choice of varieties.

(3.) ALTITUDE.

The higher the altitude, the shorter the growing season and the cooler the summer. Many varieties of fruit in higher altitudes become inferior in size, in colour, and particularly in productiveness. It is true, however, that the higher in altitude any variety can be successfully grown, the better is its texture and keeping quality. Practically no fruit is being produced in British Columbia over 3,500 feet above sea-level, and it is very unlikely that commercial fruit-growing can be conducted successfully over 2,000 feet, except in specially favoured locations where, either from the topography of the land or the mildness of the climate, or exceptionally remunerative local markets, the detrimental effects of high altitudes are discounted.

None of the Interior fruit sections of British Columbia have an altitude of less than 800 feet, and the average altitude at which fruit is being produced in largest quantity commercially at the present time is between 1,200 and 1,400 feet. The fruit produced at 1,600 to 2,000 feet is, however, notably good in keeping quality and for dessert purposes. At the higher altitudes many varieties, which are only fall apples ordinarily, become good Christmas or even late winter apples.

(4.) THE INFLUENCE OF THE ORCHARD-SITE ON THE CHOICE OF VARIETIES.

The proximity of the orchard to large bodies of open water has many beneficial effects in the prevention of frost, in the modification of winter temperature, and in increasing the humidity of the air. Such a location is desirable for practically all kinds of fruit, but is especially desirable where tender varieties or those subject to frost are most desired. The presence of deep water is one of the best forms of insurance, in planting any kind of fruit, against vicissitudes of climate at any

time of the year. At the same time, proximity to the sea carries these good qualities to an extreme, reducing the summer temperature so greatly that grapes, peaches, and other fruits requiring high temperatures in summer, do not thrive, and winter apples take a long time to properly mature.

The slope of the land is important. A reasonably level orchard costs less to operate. On the Coast, the most desirable slope for practically all kinds of fruit is that to the south or south-west, so as to secure the benefit of all the sun possible. In the Dry Belt, such an exposure lends itself too readily to sun-scald, and on extreme south-west slopes this may become quite serious, even with low-headed trees and hardy varieties. Too great a slope increases the cost of irrigation (and the danger of washing), as does an uneven slope or an absolute absence of it. Grading is often necessary in irrigation districts to ensure a proper flow of water. A slope to the east or south-east renders the fruit, plums especially, more susceptible to spring frosts, and so is not desirable where spring frosts are liable to be prevalent.

Elevation above the low-lying land of a district greatly facilitates air-drainage, and so assists in avoiding spring frosts in every district, while on the Coast, as stated above, it helps materially in securing freedom from fog.

In districts with prevailing winds or heavy winds from any particular direction, it is desirable to have the orchard protected from such exposure, or if an orchard is planted in such a location, the varieties should be those which resist such conditions to best advantage. The Wealthy, McIntosh, Snow, and some other varieties drop readily before maturity in a high wind, while others, such as the Crabs, Wagener, Winter Banana, Yellow Newtown, and Golden Russet hang well to the trees under such circumstances. Transcendent crab, in the Interior, and Hyslop crab, on the Coast, are good varieties for the exposed side of the orchard.

While on the Coast a slope down to the water and facing south-westerly is, as a general rule, most desirable for apples, for strawberries it may be detrimental, because of the exposure to the prevalent south-west wind of that section. In the Interior, it is a general rule that a slope down to an open body of water should be chosen; where this is available, the other considerations as to site are secondary.

(5.) FRUIT-GROWING SOILS.

The Province has soils of a great many types. Speaking generally, in the whole of the Coast region the soils which are suitable for fruit-growing are nearly all of glacial origin, while in the Interior practically all are of an ancient alluvial character, either being on the floor of prehistoric lakes, or the wash of more recent mountain-streams. In both cases there is a wide variation of type, whose influence on fruit-growing we are just beginning to understand. Much in this respect has yet to be learned by experience, but we are able to make some definite recommendations at this time.

(6.) THE TYPE OF SOIL.

On light or sandy soils, early maturing fruits and those whose roots naturally require a light soil, such as peaches, plums, and apricots, are likely to do best. On the clay loams and slightly heavier soils, many varieties of apples are thriving to their greatest perfection, while pears prefer distinctly heavy soils. Clay soils, with heavy clay subsoils, are not at all suitable when they do not yield up their moisture readily to the tree or to the plant, and on such soils strawberries are extremely likely to suffer from want of moisture, even though a great deal may be present. As strawberries, however, require a considerable amount of moisture, the soil should be retentive in character. Blackberries and currants prefer a low, moist, fairly heavy soil, while raspberries require it well drained, but still deep and moist. Under irrigation conditions these factors are all modified somewhat, but the type of soil is one which should be given due consideration in the planting of all kinds of fruits.

There has been very much indiscriminate planting of fruits on very light, gravelly, or open soils, on which trees may do well for a few years with sufficient cultivation or water, but where eventually failure seems certain. Soils of basaltic origin or of quartz are likely to be open and poor in potash, while those of feldspathic

type are usually rich in both potash and lime, though variable in phosphoric acid. For practically all fruits it is desirable to have a type of soil which carries a quantity of plant-food in a reasonably available form.

Whatever the soil, it should be reasonably deep. Sour cherries, and in some cases strawberries and plums, may do well on soils which are rendered shallow by the presence of hard-pan, impervious clay subsoil, or rock; but on such soils apple-orchards are likely to be short-lived, poor in results, and extremely liable to winter injury. Shallow soils have not sufficient reservoir for moisture, nor have they any reserve of plant-food, and they should be avoided for what are intended to be long-lived orchards to a far greater extent than they have been in the past.

The depth of soil is a subject which receives practically little or no consideration from the intending planter, yet it is one on which the future of the orchard very largely depends.

The amount of decayed vegetable matter or humus in the soil varies greatly in different districts. Humus is almost absent in Dry Belt soils, but what there is is four times as rich in nitrogen as the average humus of the soils of humid regions. Soils which have been newly cleared of coniferous timber are deficient in humus, and what there is is undesirable, because of its acidity or rawness. Those soils which have borne a natural growth of willow or alder have more humus, and consequently more available nitrogen; but, generally speaking, nearly all our soils lack in this essential constituent, and it must be supplied at some time, either before the orchard is planted or in its early years. If humus is lacking, the roots of fruit-trees, which are very much more delicate and exacting in their requirements than the roots of forest trees—general opinion to the contrary—make much less growth, and the trees in consequence do not do so well. Practical experience proves that humus should be supplied early in the life of the orchard, and, preferably, a crop of clover, vetch, alfalfa, or peas should be ploughed down in the fall before the orchard is planted.

In most sections the presence of a supply of sub-irrigation moisture, or seepage, will be of great benefit if it is not in too great quantity or too near the surface. We find apple-orchards on the Coast doing best where there is such subsoil moisture as will ensure a supply during the dry summer. Such seepage is also giving good results in sections of the Interior, but where subsoil moisture is in apparent excess for the average apple-tree, pears may be planted with satisfactory results.

On soils which show alkali, or which will be subject to alkali, through seepage or over-irrigation, the best varieties of pears should be planted rather than apples, because the pears stand alkali much better. Where alkali is present in considerable quantity, the grape, which is more resistant even than the pear, will still do well. The peach is not at all resistant, and its planting on such soils should be avoided.

The drainage of the orchard-site should be good. Where it is desirable to have a home orchard on low soils which are unsuitable for commercial orchards, those varieties of apples such as Golden Russet and Ben Davis, which are specially resistant to soil-moisture, should be chosen.

(7.) THE POLLINATION PROBLEM.

It has been learned within comparatively recent years that the pollen of one variety of apple may not be potent on the blossoms of the same kind, though quite efficient on another variety. There have been found but a few varieties of apples and of pears which are self-fertile, and occasionally instances have been found where the pollen of certain varieties will not fertilize any other variety on which it has been artificially tried. The study of pollination has solved many problems as to the failure of orchards, especially those of a single variety, to bear normal crops of fruit. Such studies also indicate the best varieties for planting together to secure best results, but only in the district in which the experiments are conducted, as is shown by the widely different conclusions of experimenters. The results of investigators in other Provinces and States are therefore not presented here.

No pollination studies have been conducted in British Columbia, this being a subject of scientific investigation for which we have not as yet had the facilities.

Under the circumstances, our recommendation to each intending planter is that he put in from three to five varieties of apples in blocks of not more than four rows of each kind, so as to permit bees to cross-pollinate them. It has been found, we might add, that cross-pollination very often increases the colour and the size, as well as the quantity of fruit produced. To pollinate successfully, varieties must bloom at the same time. Practically all the fertilization of fruit-blossoms is done by bees, of which every fruit-grower should keep a few colonies for the purpose.

(8.) THE INFLUENCE OF VARIETY CHARACTERISTICS.

Presuming that we have the most favourable climatic and soil conditions to produce several varieties of fruit to their best individual advantage, we must decide on those varieties which have the greatest number of desirable characteristics. If, for instance, Spitzenberg and Winesap are each suited to certain soil and climatic conditions, we would unhesitatingly choose the Winesap, because it will usually bear three boxes to one of Spitzenberg. If in bearing qualities the varieties are equal, we would choose the one which is an annual bearer, against the variety which bears only every alternate year. In the consideration of the varieties recommended, we have given consideration to the growing habits of the different types of trees, their vitality, their method of growth, their relative costs for pruning, their usefulness as permanent trees or as filler trees for interplanting between the permanents, their bearing habits, whether they bear at an early age, as does Wealthy, or very late in life, as with Northern Spy, or medium, as is the case with McIntosh. Only a few varieties are recommended here which have the biennial-bearing characteristic, as have Blenheim and Baldwin.

In respect to the character of the fruit, there is to be considered, besides quantity, its quality, colour, size, uniformity, and freedom from blemishes. Supposing the yield of fruit from two varieties to be equal, we would prefer that which produces the greatest percentage of high-class fruit and the smallest percentage of cull fruit. Practically no varieties are recommended which are not of high quality, of good colour, desirable size, producing uniform fruit, though there are considerable variations which must be taken into account in choosing the varieties for any particular section.

All of the factors above discussed in reference to the choice of varieties have to do with the cost of production. Our aim is to choose that group of varieties of which the unit cost of production per box will be the lowest. It is of no value to produce magnificent fruit if the cost of production is to be greater than the selling price. We know of no varieties which are likely to be more remunerative than the ones which have been chosen and published in this list.

Turning to the question of the relation of variety to the selling price, we have found it necessary to consider a number of factors which materially influence the choice, and which are discussed fully.

(9.) PROSPECTIVE PRODUCTION.

The people of our fruit districts are only beginning to realize that, important as it is for any grower to limit his list of varieties, it is equally important to each grower, and to all of them as a whole, that the number of varieties planted in the entire district be also reasonably limited. One of the greatest handicaps our young districts have is a production of such wide range of varieties as to disgust the buyer and discourage the market. In such cases there must be a general campaign conducted by the broad-minded men of the locality, to induce the owners of miscellaneous varieties either to pull out the trees or top-work them to the most desirable kinds.

The orchard survey of the fruit sections of the Province, made in 1911 and 1912 by the Department of Agriculture, has shown in a striking manner the great disadvantages under which some districts at present suffer, and will continue to suffer, from such miscellaneous selection. (See the Twenty-second Annual Report of the British Columbia Fruit-growers' Association.) This will be discussed under the heading of each district.

It must be pointed out that the districts which have been able to ship large quantities of favourite apples, such as Jonathan and McIntosh, have been able to command an average of 15 cents a box more than those districts which have but limited quantities of such kinds; and where there is a large proportion of undesirable or "odd" varieties, the effect has been to depress the price of the good varieties still further. In other words, the good varieties are used to sell the poor ones, and the planter of the good varieties suffers by just that much.

There is every reason for every district to limit its choice of varieties to not more than a dozen, which will amply cover the market. The individual grower should have not more than four or five if producing for car-load shipment.

When an intending planter must make a choice between two kinds, and other conditions appear reasonably equal, he should unhesitatingly choose that variety which has been most largely planted in the district. If this were done, it would materially assist in developing the production of the few best kinds.

The intending planter can inform himself as to what varieties have been planted most largely in his district. He is not able, however, to discover what are those varieties largely planted in other sections which will come into competition with him, and so is not in a position to judge whether any particular variety is liable to be produced in more than market requirements, or is likely to be in particular demand when his own come into bearing. On the question of the plantings made in British Columbia and the North-west States, which are our chief competitors in the box-apple trade, we have given this subject consideration, and in recommending the varieties indicated in the list have kept the influence of other plantings prominently in mind.

(10.) HOW MANY KINDS TO PLANT.

This depends much on conditions. If it is the question of supplying a local market or a special market which requires supply throughout the season, the grower would do well to plant all those kinds which are recommended for his district, even to the extent of seven or eight, or more. But for the greater part of the plantings to be made in this Province, where the market is a distant one, and where the fruit is to be handled co-operatively by the growers' organization, it is infinitely better for each grower to restrict himself to from three to five kinds. His first object in limiting the number of kinds is to enable him to study each kind and so get the utmost out of it.

We are reminded of a prominent pear-grower who said, after fifteen years' experience in growing the Bartlett pear, that he hoped in another fifteen years to understand just how that variety should be handled to best advantage in his locality. This is an extreme case; but it is a fact that each variety has its peculiarities, and that these peculiarities must be studied by the grower if he is to master them, and to mould them to his own use.

The kinds chosen must, however, be so adjusted as to make as even a demand as possible on outside labour, referring particularly to the harvesting. In this respect, it is better to have a series of varieties whose picking period extends over two and a half months than to have a group of varieties which must all be picked within two weeks. The question of supply of suitable labour is one of the problems of our fruit business, and its solution by the individual can be much facilitated by forethought in this connection.

Aside from the labour of picking, to have a few kinds lessens the cost of production in other ways, by lessening book-keeping, by lessening the amount of skilled labour required in pruning, which naturally varies in different kinds, and generally by all those little economies which come by producing a few things on a large scale, rather than a large number of things on a relatively smaller scale.

(11.) INFLUENCE OF TRANSPORTATION FACILITIES.

Fruit may be marketed by road, water, or rail, or all three; but, in any case, varieties must be chosen that will stand the transportation methods. It is practi-

cally useless to plant soft fruits where there is a haul of ten or twelve miles before the rail is reached. Similarly, fruit may be planted in a section so far from its possible markets that the transportation charges consume all the profits. The districts which require transfer from boat to rail, or a transfer en route on the rail-line, are handicapped over those which have main-line facilities.

These questions all have an important bearing on the success of the softer kinds of fruit, and the cost of transportation has an intimate bearing on the profits with every type of fruit. The reductions in freight rates and the improvements in shipping facilities which have marked the conclusion of negotiations between the British Columbia Fruit-growers' Association and the Canadian Pacific Railway are already proving a tremendous advantage to many of our districts. There is no way, however, of securing as cheap rates for a distant district as for one much nearer the market. There is a handicap in cost and time which can only be overcome by superior producing advantages or superior quality of fruit.

The Department will be glad to advise intending shippers of the present transportation rates, on both car-loads and less than car-loads, and both freight and express, to the different markets available for each district. The question of service is one which the intending planter can study for himself on the ground. He will understand readily the advantages of nearness to markets, in time consumed, in lessened handling, and in rates.

One fundamental feature of the evolution of the fruit-growing industry is the development of car-load shipments. These effect an economy in time, in rates, in handling, and in facility of marketing. Orchards so situated that they cannot readily make up car-loads for a number of years are handicapped to an extent which a man who has only reached the planting stage can scarcely realize. The assembly-rate principle, the adoption of which has been secured for our growers by the British Columbia Fruit-growers' Association, will be of some service to these scattered points, but the handicap cannot be entirely removed. The people of a new district should get together and plan the development of the district, as each does his own orchard, so as to secure shipment of straight car-loads at as early a date as possible.

(12.) MARKETS.

The list of varieties selected must meet the market. This question is the one which receives first consideration, and in some cases entire consideration, the varieties being chosen entirely with reference to market requirements, to the entire neglect of cost of production and all that enters into it. We aim to choose varieties for which the net price received per box is as much above the net cost of production per box as possible. Those varieties for which higher prices are paid in the market are not necessarily the most profitable ones.

It is only a few years since certain varieties, then in the nature of novelties, fetched extremely high prices, and were in consequence heavily planted, and have now reached the market-level warranted by their intrinsic value. It is a serious mistake to plant a variety on the fashion of the moment. The effort should be to plant varieties which have real intrinsic merit, and which, from the character of the fruit, are likely to meet a stable market for a considerable period. It is not possible for any one to forecast the market indefinitely, but we endeavour to choose varieties which are likely to meet the requirements of our various markets, as far as we can at present foresee the demand.

The Canadian Prairie Provinces, Alberta, Saskatchewan, and Manitoba, furnish the logical market for the great bulk of the fruit produced in the Interior of the Province. The consumption in the Prairies is increasing tremendously with their rapid growth in population and in wealth.

Sour cherries are usually in great demand, but they must be marketed when the rush of sweet cherries is over.

We have never supplied one-half of the demand for strawberries, but require a greater organization, so as to ship car-load lots by express, to do much in this line.

The demand for raspberries, blackberries, and other small fruits is now largely supplied by imported fruit, and in this case, as in strawberries, the great necessity is for greater production and organization, so as to market in straight car-loads by express.

There is considerable outlet for a further supply of sweet cherries, but not of the softer and light-coloured varieties, the dark cherries being in demand.

Early plums have always paid a remunerative price, and as a rule late plums and prunes have also been very satisfactory. The latter are used more largely for preserving purposes, and on this account shipments should be made in the cheapest package—viz., the peach-box. Early varieties of peaches of nearly all kinds fetch remunerative prices, but later in the season only yellow-fleshed and freestone varieties are desired; indications are that, even with proper kinds, peach prices are likely to be comparatively unremunerative for several years.

It is likely that present plantings of peaches will largely take care of this market. In pears the demand has, as a rule, been very good, and fully warrants the extensive plantings made in recent years, and we believe, also, further plantings in those districts suitable for commercial pear-culture. The Prairie demand for apples, both early and late, has heretofore been very good, and is likely to continue so. As a rule, red apples are desired, and the higher grade and larger sizes, which find favour in the big cities, are not so much desired as medium-sized, well-coloured fruit at a moderate price. The varieties of apples recommended are calculated to meet this demand. Our problem will be to get our share of the trade, and do it at a reasonable profit.

Our great problem in the Prairie and Coast markets is most certainly that of our competition. The fruit of Ontario and Nova Scotia has a more or less distinct market of its own, but the North-western States, Washington, Idaho, Oregon, and Montana, compete directly with us in our own lines, and at the present time supply the bulk of the trade. It has been assumed that, as our production increased, these markets would come to us naturally and without difficulty by reason of our advantages of lower freight rates and the protecting Customs tariff. Actual experience in the past three years demonstrates that the task will be a much more difficult one. Our competitors to the south have several advantages, which at present more than offset ours mentioned above: an earlier season which enables them to supply the markets before our fruit is ripe; an older industry, with all that it means in skilful production, packing, and selling; lower costs of labour, money, supplies, and of living; an established trade in our natural markets, which they have supplied in larger measure than we have up to the present; and the control of many of the Prairie fruit-jobbing houses by one body of United States men and capital. Obviously, some of these advantages will be overcome naturally in the rapid increase of our production, but the market will not become ours without effort, and, perhaps, not without considerable expenditure for a separate distributing organization.

This American competition in the markets of Western Canada is perhaps the greatest problem of our industry to-day, and it promises to remain a big question for some time.

In observing the general trend of crops and prices as they will affect our future markets, it is worth noting that in the decade 1900-1910 the production of various soft fruits in the United States increased much more rapidly than the population. Plums and prunes increased 76 per cent.; apricots, 57 per cent.; cherries 43 per cent.; grapes, 100 per cent.; and peaches, over 100 per cent. Since 1910 the tendency has been to still further increase, the 1912 crop being much the largest yet produced and far exceeding 1910, which was the largest up to that time.

A similar increase in production has taken place in Eastern Canada, while the fruit industry of British Columbia has been practically created since 1900.

Under these circumstances of production, it would not be right to expect a general high range of prices for the soft fruits in our competitive markets, and this would affect us more severely than others, because of our present higher costs of production and the fact that our fruits come on the markets when prices are lowest.

Under such conditions as obtained in 1910 and 1912, when hundreds of car-loads of American fruit were consigned to the already overloaded Canadian markets, to be sold for what buyers would give, the effect was to force prices down, sometimes even below the barest cost of production.

The general outlook for apples and pears is more satisfactory. The production of apples in the United States dropped about 27,000,000 bushels in 1910 from the 1906 level, and while there is apparently some ground for the belief that production is once more on the increase, still the market may not be fully supplied for some time. The North-western States are our direct competitors in apple-production as in soft fruits, and their yields will increase rapidly in the next few years. While they had about 18,000 acres of apples in bearing in 1912, which produced about 15,000 car-loads, there are a total of 285,000 acres planted, which, if the whole were to succeed, might easily produce 50,000,000 or 60,000,000 boxes in 1920, which is about half the present production of the entire United States. As it is true, however, that only about 20 per cent. of this may be expected to arrive at commercial bearing, production will not be nearly so large as these optimistic estimates would indicate. It might easily happen, however, that prices will have to decline somewhat to bring the inevitable increase in supply into consumption.

It is possible that intending apple-growers should not base their plantings on the expectation of prices higher than an average of \$1 a box for good fruit. At such a figure there will undoubtedly be a satisfactory profit in bearing orchards in our proved fruit-growing districts.

To ensure results, the planting of orchards will require the most careful selection of varieties, soil, location, and district. There must be, furthermore, constant and careful attention to the details of management and operations, having in view the greatest economy in production. There must also be economical and efficient marketing, which may be ensured by large shipments under the smallest possible number of competing organizations.

British Columbia Coast cities, which have been making marvellous growth of recent years, have far outrun the supply of fruit grown on the Coast in practically everything, and it seems likely that plantings of all kinds that are reasonably suited to the Coast conditions will find a ready local market. The grower having little or no freight rate to pay, no duty, or inspection fees, is at a considerable advantage over his more distant competitors. The general demand of the Coast is about the same as that of the Prairie, save that prices are, as a rule, not quite so high; there is less demand for crab-apples, and there is more competition from cheap fruit peddled from door to door in the cities.

The Interior districts are beginning to look to the Coast to dispose of part of their output, to some extent for peaches, but largely for apples. The McIntosh, Jonathan, Wagener, and similar varieties, produced in the Interior, will find a very satisfactory market, which has been very largely supplied by foreign shipments up to this time.

Australia and New Zealand offer a very remunerative market for small, perfect red apples, and for pears suitable for November and December trade. Shipments have been steadily growing, and as more fruit of the kind required becomes available the high prices paid by this market will undoubtedly cause a great expansion in this trade, we believe to the possible extent of 200,000 boxes, in a few years.

China, Japan, the Philippines, and India have barely been touched as yet, but promise to take quite a large quantity of apples in a few years. Here, as in Australia, the demand is for the small, perfect red apple.

The demand in Great Britain, which we have only begun to cater to, is more for yellow than red kinds, but red dessert apples of certain varieties meet with ready sale. Yellow Newtown and Winter Banana from British Columbia sell particularly well. The facilities for shipment to England are good, and as our production increases the market will become a very large one. Reports from Canadian Trade Commissioners in South America and inquiries from houses there indicate that there will be a big demand for our apples in the large cities on the eastern coast of South

America. It is reasonably expected that this is a trade which can be catered to on the completion of the Panama Canal to greater advantage than at present.

COMMENTS ON USING LISTS.

In the use of the lists which follow, the following points should be observed:—

The list has reference mainly to the varieties of greatest commercial value, which are marked in each case with an asterisk, and to those most desirable for home orchard planting.

No attempt has been made to include those numerous varieties which may be of value for those local or special markets which are often to be found by the man who will cater to them.

The list for each district is not large. There are many other varieties which do well, and still others may be profitable. But there is a great economy in having but a few kinds rather than many.

Local associations, such as the farmers' institutes, the agricultural associations, and the fruit-growers' associations, should make strong efforts to influence the new plantings of the district. No grower lives to himself alone. His bad choice hurts the district as well as himself. It is suggested that local organizations conduct a series of meetings, to make a choice of varieties for recommendation. In making this list, the Assistant Horticulturist for the district and the Department of Agriculture might very well be consulted. Having adopted a list, changes should be made in it only with the greatest care, and every effort should be made to give it publicity and to secure its adoption and use.

The list for home orchard planting is deemed fairly complete for the average home. There are many other good kinds which could be profitably included if the land and time and money are available for them. In all those cases where the intending grower feels that the list does not meet his requirements or his conditions, the Department will be at his service in advising on the kinds most likely to bring results. Letters on this subject should be addressed to the Provincial Horticulturist at Victoria.

It is not recommended that each orchard-planter should put in all the kinds recommended for commercial planting for his section. Rather should he select the three or four which are best adapted to his own conditions, of location, soil, etc. If the entire list recommended for the district is considered by each planter, the effect will be to give the district a continuous line of fruit, to keep the packing-houses open and to supply the markets.

It is far from being the intention of the Department, in issuing this list, to discourage experimental work with new or untried varieties. In every section of the Province there is much information to be had from testing both old and new varieties of all kinds. Such experiments, if conducted on a large scale, are almost certain to result in loss to the experimenter, great as their value to the district as a whole. Every fruit-grower might well do a little experimenting with a few varieties, but two or three trees of each kind are sufficient.

Even with the greatest care in its compilation, the list offered is not absolute. It cannot be accepted as final. It would be a mistake for any intending fruit-grower to take the recommendations for his district as applicable entirely to his own piece of land.

Our conclusions as to varieties, carefully as they may be made, may be materially changed in the course of years. We are only at the beginning of a real understanding of our different districts and their soils. The problem of markets has only been presented. Our markets have already established preferences for some varieties we do not produce to advantage, as, for instance, the Winesap, and things of this kind will continually have to be met and overcome.

The great problem in the search for suitable varieties is to find kinds to supply the late winter and spring demand for apples. We have no variety that altogether meets the requirements—a high-quality, long-keeping red apple of good size, borne on a hardy and productive tree. None of our present kinds meet these requirements fully enough.

LIST OF DISTRICTS.

- (1.) Vancouver Island—South-east Section.
- (2.) Vancouver Island—West Coast.
- (3.) Mainland Coast.
- (4.) Northern Coast Valleys.
- (5.) Lower Mainland.
- (6.) Lytton, Lillooet, Spence's Bridge.
- (7.) Kamloops-Walhachin.
- (8.) Southern Central Plateau.
- (9.) Shuswap Lake.
- (10.) Upper Okanagan Lake.
- (11.) Lower Okanagan Lake.
- (12.) Similkameen.
- (13.) Kettle River.
- (14.) West Kootenay.
- (15.) East Kootenay.
- (16.) Central British Columbia.

(1.) VANCOUVER ISLAND—SOUTH-EAST SECTION.

This district, roughly speaking, comprises the cultivable areas included in the boundaries shown on the map. The principal settlements of the district are those around Victoria, along the line of the E. & N. Railway, at Comox, and on the Gulf Islands contiguous to the east coast. A considerable proportion of this area, which is about 180 miles in length, may be cultivated, and much has already been cleared. The rural population at present might be estimated roughly at 15,000, and the principal industry is mixed farming, with dairying as its basis; poultry-keeping; and fruit-growing, the latter being largely restricted to the sections having reasonable transportation facilities.

The climate is essentially mild and moist, due to the influence of the Japan Current. The growing season is long, but cool, and the winters are damp and mild, with occasional frosts and rare freezes. The precipitation varies from an average of 28 inches annually at Victoria, 40 at Duncan, 42 at Nanaimo, to 70 at Alberni, the greater part occurring in the winter months. In the greater part of the district, precipitation in the summer is light, that for Victoria in June, July, and August being the lowest recorded for any point in Canada. The summer drought characteristic of the entire district is modified by the prevailing dampness of the air; the blooming season extends over a long period, and the blossoms, as in all Coast districts, are more subject to frost in consequence.

The soils of the district are very diverse in character, but are similar in being largely of glacial origin. Except in the lowlands, they are usually medium to light in character, and are often underlaid with hard-pan at a depth of 18 to 30 inches from the surface. A red, sandy, gravelly loam is the most usual upland soil, and the one on which most of the fruit-growing is conducted. Most soils are deficient in lime, but have fair amounts of nitrogen, potash, and usually phosphoric acid, and respond readily to applications of manure and fertilizers.

The Douglas fir is the principal forest tree, and with it are associated more or less balsam, spruce, and cedar. The only British Columbia oak (*Quercus garryana*) is a characteristic feature of many landscapes around Victoria and the Saanich Peninsula.

The markets for the produce of this district are practically altogether local. Up to a few years ago, when the rapid expansion of the Coast cities began, it was expected that the Prairie would be the eventual outlet for fruit, but the rapidly increasing local population has now far outstripped the production of

nearly all kinds of fruit except preserving cherries, so that there is no need, either present or prospective, to look farther afield for a market. Competition in fruits on local markets comes very largely from the State of Washington, and to an increasing extent from the Interior sections of our own Province, but the handicap of duty and freight in the former instance, and freight in the latter, gives the local product an advantage which helps to offset some local disadvantages in the cost of production and the quality of the product.

The fruit-growing industry in this district had its period of greatest expansion in the years from 1904 to 1908. Experience has already begun to demonstrate that this development was, after all, more in the nature of an experiment, and some temporary set-backs, combined with great material prosperity in other lines and a tremendous increase in land-values, have operated to direct attention away from the possibilities of fruit-production. There has been some neglect of both young and bearing orchards, and this is a district where the best of care is absolutely necessary to profit.

The present production centres most largely around strawberries, principally the Magoon variety; preserving cherries, principally the Olivet and English Morello; plums and prunes of mixed varieties, but principally Black Diamond, Pond's Seedling, and Italian Prune; a few pears of numerous varieties; and apples quite largely Duchess, Wealthy, and King. Many varieties of winter apples have proven unprofitable, but many orchards planted to correct varieties have proven unprofitable because of unwise selection of location.

Given care in the choice of location and soil, with special reference to varieties and to markets, fruit-growing will be a profitable industry in this district. A great proportion of the cultivable area, however, should be retained for other forms of agriculture more adapted to its conditions.

The list of fruits recommended is as follows:—

Strawberries—

Excelsior—Early.

*Magoon—Good, firm shipping berry; most useful kind grown here.

*Sharpless—Valued for local market.

Warfield—Second early.

Raspberries—

Marlborough—Early crop.

*Cuthbert—Main crop; fine commercial kind.

*Loganberry—Profitable commercially for local market; fine for canning and preserving.

Gooseberries—

*Oregon Champion—Small berry, but free from mildew and productive.

Downing }
Industry } Good for home use.

Blackberries—

Snyder—Good quality; early.

Evergreen—Very productive and vigorous; late; quality low.

Red Currants—

Cherry—Large, but somewhat soft.

Fay's Prolific—Firmer, but smaller.

Preserving Cherries—

*Olivet—The best commercially; a fine money-maker.

*English Morello—Good for fillers in Olivet plantings.

Dyehouse—Earlier than Olivet and Morello.

Sweet Cherries—

Reine Hortense—Very early; soft; home use.

*Royal Anne—Early; white; rather soft; good for home or local market.

*Bing—Late; very good for home or any market.

Lambert—Very late; good, but light bearer.

Peaches—

Hale's Early	} For home use only; must be trained against walls to secure ripening.
Early Charlotte	
Alexander	
Early Crawford	

Grapes—

Moore's Early	} Home use; must have sunny exposure and warmth to ripen.
Campbell's Early	
Concord	

Plums and Prunes—

- Peach Plum—Early and large; but soft and coarse and inclined to rot.
 Czar—Medium early; small; good cropper.

*Engelbert—Very good for home or market.

*Italian—Late; a general favourite.

Victoria—Late; very high quality.

Reine Claude—The best greengage.

Shropshire Damson—The best for jams.

Crab-apples—

Hyslop—Does better than any other crab yet grown.

Pears—

*Bartlett—The standard early pear.

*Louise Bonne—Small on dry soils, otherwise very good.

*Bosc—Scab-proof; high quality; October.

*Clairgeau—November.

*Anjou—Very good.

Seckel	} High-quality pears for early winter home use.
Comice	

Apples—

Yellow Transparent—Very early.

*Duchess—Next early; gets size on dry soils.

*Wealthy—Fall; must have medium moist soil.

Gravenstein—High quality, but takes much attention.

*King—Best late apple here.

Grimes Golden

Blenheim Orange	} The most promising of late varieties.
Wagener	

Cox's Orange—A good, small dessert apple for November and December.

(2.) VANCOUVER ISLAND, WEST COAST.

The boundaries given for this district are as indicated on the map, and show in a general way the area included. The list is given as a suggestion for those sections which have the conditions here described. The climate is quite moist, being exposed more or less to the full sweep of the Pacific, with an annual precipitation of from 70 to 125 inches, practically all in the form of rain, occurring most largely in the winter months and least in July and August. The summers are cool, though July and August have considerable sunshine. The great precipitation and the high relative humidity throughout the year make fungous diseases especially troublesome to the fruit-grower, and even with those varieties recommended below, which are least subject to such diseases, the task of producing clean fruit is not easy.

Inside the boundaries given on the map there are many sheltered districts, where, because of elevation, good soil-drainage, exposure to the sun, and freedom from frosts and fog, the conditions are more like those obtained in District No. 1, and where this is the case the variety list given for that section may be safely followed, due consideration, however, being given to transportation facilities.

The soils of the district are very much like those of the south-eastern half of the Island, as described above, but have been subject to much greater washing and leaching of plant-food. The greater precipitation in spring, summer, and autumn months renders them much less liable to drought and adapts the district for dairying.

The west coast is comparatively a new country, which has been much handicapped by lack of transportation. The local population is small, but the local fruit-production at present does not supply its demands. Most hardy fruit consumed in the section is supplied by Victoria fruit-jobbers.

Commercial production of fruit for shipment is not likely to be undertaken, but it is eminently desirable that the home orchard in this district, such as will supply at least the bulk of the fruit used by the farmer, should receive consideration.

The list of fruits recommended is more or less tentative in character, but an effort has been made to name those varieties which are likely to thrive best under the conditions.

Strawberries—

Warfield—Earliest.

Clark's Seedling—Firm; late crop.

Dunlop—Second early.

Raspberries—

Cuthbert.

Loganberry.

Gooseberry—

Oregon Champion.

Blackberries—

Snyder.

Evergreen.

Red Currant—

Cherry.

Sour Cherry—

Olivet.

English Morello.

Peaches—

Early Charlotte	} Must have sunny wall.
Early Crawford	

Grapes—

Moore's Early—Must have sunny wall.

Plums and Prunes—

Englebert	} Small plums, but fairly clean growers.
Monarch	

Reine Claude—For preserving, etc.

Shropshire Damson—For jam-making.

Crab-apples—

Hyslop.

Pears—

Bartlett—A cosmopolitan variety worth trying.

Boussock	} Scab-resistant; good croppers.
Bosc	

Anjou—Late; high quality; worth test.

Keiffer—Long-keeping.

Apples—

Yellow Transparent—Very early.

Duchess—Second early.

Wealthy—Early fall.

Alexander—Early fall; cooking.

Gravenstein—Fall; dessert.

King—Early winter; dessert and cooking.

Canada Reinette—A clean-growing early winter yellow apple.

Wagener—A cosmopolitan winter apple worth trying.

(3.) MAINLAND COAST.

Reference to the map will show that there has been included in this district the greater part of the Coast region of British Columbia, including the north-east half

of Vancouver Island, with adjacent islands, and the mainland coast from Howe Sound north to Bella Coola. In this great area settlement is sparse, and the energies of the settlers are largely devoted to lumbering and fishing. There is one agricultural community of long standing, viz., that of Bella Coola, but only a small portion of the Bella Coola Valley is similar in conditions to the greater part of the Coast.

Of the climate we have very few records. They indicate that in general it is very moist, varying from 50 to 140 inches precipitation, with long but cool growing seasons, and wet and occasionally cold winters. Great variations in conditions exist, but so little development has been done, and that so recently, that little definite information can be recorded as to climate.

The soils are largely gravelly, and much of the same character as described for Vancouver Island, but there are large areas of gravelly soil, as well as many deltas of small size, now heavily timbered, composed of rich, deep, and fertile soils. As on the west coast of Vancouver Island, timber is very heavy, and the cost of clearing very great, while transportation facilities for the greater part of the territory are meagre.

The market available is a local one, and is far in excess of the local attempts to supply it in any foodstuffs, while the fruit grown meets a very ready sale in competition with fruit distributed out of Vancouver and Victoria. The present production of fruit is quite small, and not very much planting of trees has been done as yet.

The list suggested for settlers on the West Coast of Vancouver Island is recommended for this district also, the conditions being similar.

(4.) NORTHERN COAST VALLEYS.

This district includes the agricultural areas lying in the lower valleys of the Nass, Kitsumgallum, and Kitimat Rivers, and Lakelse Lake. This is a new district, attention to which has been attracted because the Grand Trunk Pacific cuts through it between the Lakelse and Kitsumgallum Valleys. In size, none of these valleys are large, but there is a total of probably half a million acres of land which will eventually be brought under cultivation.

The climate is unusually mild for a district of such high latitude, but it is not nearly so moist as the Coast regions, only a short distance away, beyond the Cascades. The total precipitation is probably between 30 and 50 inches, and a great deal of it comes as snow, which lies from December till March over the entire area. The summers are warmer than on the Coast, and June is the only summer month having considerable precipitation. The winters, while fairly long, are mild, probably not more severe than at Nelson, in this respect being suitable for many kinds of fruits. The growing season, while of moderate length, is cool. No figures have been kept as to either temperature or precipitation.

The soils are extremely variable, and are largely composed of the wash of the mountain-sides into the valleys. A great deal of the soil is of the highest quality, though much of it is underlaid with open gravel, which detracts considerably from its agricultural value.

The timber is not heavy, but under present conditions of labour would cost from \$100 to \$125 an acre to clear, and proportionately less as the district becomes more settled and the cost of labour equalizes with that farther south.

The market for whatever this district can produce lies at its door in the growing city of Prince Rupert, and along the line of the G.T.P. east to Edmonton. Interest centres in this district because it is likely to be the only large area in the north which will produce a wide range of fruit in such commercial quantity as to compete with the fruit from farther south, which it would be enabled to do by its advantage of position. Prince Rupert is now supplied altogether with fruit by boat from Vancouver, and the strawberries produced in this district for the past three years sold at an average of \$6 per 24-lb. crate delivered at the boat on the Skeena River.

The local population is small, but there was practically no one resident in the district five years ago. The land is largely held by pre-emptors and by land com-

panies under purchase. Very little clearing has as yet been done, and the Department of Agriculture's experimental trees, planted during the last two years, form the majority of the trees planted. The list of fruits recommended is not, therefore, given from local experience, but is designed to be of use as suggesting those varieties which are likely to do well in the district, and to find favour in the markets in competition with southern fruit.

Strawberries—

Magoon.

Wilson.

Raspberries—

Cuthbert.

Herbert.

Red Currants—

Red Dutch.

Ruby Castle.

Gooseberries—

Champion.

Red Jacket.

Whitesmith.

Sour Cherries—

English Morello.

Early Richmond.

Ostheim.

Sweet Cherries—

Reine Hortense.

Royal Anne.

Bing.

Plums and Prunes—

Czar.

Monarch.

Reine Claude.

Englebert.

Shropshire Damson.

Crab-apples—

Hyslop.

Transcendent.

Pears—

Bartlett.

Bosc.

Clairgeau.

Anjou.

Apples—

Yellow Transparent.

Duchess.

Wealthy.

Alexander.

Wagner.

McIntosh.

Scott's Winter.

(5.) LOWER MAINLAND.

This district embraces what is usually known as the Lower Fraser Valley. It is the territory tributary to New Westminster and Vancouver. In size, it is about 130 miles long and up to forty miles wide, and is the most developed, the oldest and largest agricultural community in the Province, with settlements close together, territories well served by electric and steam railway-lines, as well as by navigable waterways.

The climate of the western half is characteristically coastal, but the eastern half has some features which are of a continental character. The growing season is long, but not so long as that of Victoria, and is moderately cool, the hottest six weeks averaging about 4 degrees higher than Victoria, and about 6 degrees lower than in the Dry Belt. Both the fall and spring are long, the winter is short, usually mild, and snow may lie to varying depths for several weeks, especially in the eastern half. A few degrees below zero is known, but is unusual. The winter precipitation, which is mostly rain, is heavy. Considerable fog and haze characterize the fall months, and the fall rains set in about September 15th. The district is pre-eminently suited to dairying, and has many features which make it unsurpassed in Canada for various types of small fruits.

The soils, while variable, may be characterized as upland and lowland or delta. The latter are usually deep, though not suited, as a rule, to fruit-growing, except for small fruits for the cannery. The uplands are variable, of glacial origin, have some of the hard-pan which is so prevalent in the south-eastern section of Vancouver Island, but also have many deep rich soils of the greatest value for small-fruit production. In some sections the uplands are quite heavy, and admirably adapted for pears. As in all other parts of the Province, there is a considerable portion of the land which is gravelly or light in character, less favourable for production than the better soils. The uplands, though usually deficient in lime, are well supplied with potash and have fair amounts of phosphoric acid. On all lands the addition of potash is very valuable in securing greater firmness of fruit.

The market for the product of this area is being found very largely in the Coast cities and in the canning-factories, while the shipment of small fruits, cherries, plums, and prunes, by express to Prairie points, which has been large in volume for a number of years, promises to continue so. On the Coast these fruits meet with competition from the American side, but the tariff duties and higher freight rates give valuable protection, though the lack of organization among the shippers gives rise to a lot of irresponsible consignment, and makes the crop unwieldy and less satisfactory to both shipper and receiver than the straight car-load shipments furnished by competition.

Fruit-growing began in this territory with the planting of trees by the Hudson's Bay Company at Fort Langley. The first settlers in Chilliwack and Langley were mostly from Ontario, and planted many orchards between 1880 and 1895, principally to a mixture of Ontario varieties of apples, plums, and pears, which have furnished a great deal of information to guide the later planting in the district. Along the main line of the C.P.R., plums and prunes, as well as small fruits, were largely taken up between 1890 and 1905, though plum and prune planting received a great set-back some twelve years ago through the introduction of the brown-rot fungus, which under the favourable conditions of a moist climate has greatly restricted the shipping capabilities of all stone-fruits. The efforts to find good commercial varieties of plums which are immune from plum-rot have not been a success, and the development of the canneries in recent years, which promises to furnish a safe and reasonably remunerative market for these fruits, is most welcome.

The general experience in planting apples has not been favourable. Some shippers made good money for years out of early varieties of apples, and a few of the later kinds have given fair success, but most varieties do not succeed. Pears grow well, produce abundantly, but plantings so far have not been large enough to enable shippers to undertake car-load shipments to Prairie points, local production not yet meeting the entire demand of the Coast cities. Strawberries for local markets and express shipments to the Prairie do well, while raspberries are equally profitable. Sour cherries have been but little tried, but sweet cherries do well, more especially for local shipments. Grapes and peaches succeed only under the most favourable conditions, as is true in all Coast regions.

The Lower Mainland is not pre-eminently a fruit-growing section. Greater profits are to be made in the cultivation of vegetables, in dairying, poultry-raising, and in intensive mixed farming. In all of these lines a large market lies at the

producer's door. In fruit-growing the principal future development will be along the line of various small fruits, pears, and some early apples.

The age of the district and the great amount of experimenting that has been done make possible the recommendation of a well-trying list of varieties.

Strawberries—

Excelsior—Very early.

Warfield—Second early.

*Dunlop—The favourite berry for this section.

Marshall—Does well; earlier than Dunlap.

Magoon—Good for local shipments and the cannery.

Raspberries—

Marlborough.

*Cuthbert—Grown almost exclusively.

Gooseberries—

*Oregon Champion—Grown almost exclusively.

Downing.

Industry.

Blackberries—

*Snyder.

*Taylor.

*Evergreen.

Red Currants—

Cherry.

Victoria.

Black Currant—Naples.

Sour Cherries—

English Morello.

Olivet.

Sweet Cherries—

Reine Hortense—Early.

*Royal Anne—A favourite for canning.

*Bing—The favourite black cherry.

Lambert—Very late.

Peaches—

Early Charlotte

Alexander

Hale's Early

Early Crawford

} Must have very warm and sunny location, and do best
against a south wall.

Grapes—

Moore's Early

Campbell's Early

Concord

} Must have warmth and air.

Plums and Prunes—

*Monarch—Shipping.

*Italian Prune—For canning and shipping.

Reine Claude—Home use.

Shropshire Damson—Home use.

Crab-apples—

*Hyslop—The best for this section.

Pears—

*Bartlett—The standard fall pear.

*Bosc—Later than Bartlett; a good variety.

*Boussock—Large and scab-proof.

*Clairgeau—November.

*Anjou—Late November; a very fine pear.

Louise Bonne—Heavy-bearing; small.

Comice—Very high-quality; Christmas pear.

Seckel—High quality; long-keeping.

Apples—

*Yellow Transparent	}	Home use; express shipments.
*Duchess		
Wealthy.		
Alexander.		
Gravenstein—Highest quality.		
*King	}	Suitable December apples.
Blenheim Orange		
Grimes Golden—Worthy of trial for January and later.		

(6.) LYTTON, LILLOOET, SPENCE'S BRIDGE.

This district includes the lower levels, at from 800 to 1,200 feet elevation. in the valleys of the Fraser and Thompson Rivers, as indicated on the map. This lies just east of the Cascade Mountains, and is one of the very driest parts of the Dry Belt, the total precipitation averaging around 8 inches, which falls pretty uniformly throughout the year at the rate of about $\frac{2}{3}$ inches a month. The snowfall is light, and of not much use as a protection to trees or for sleighing. The district is divided from those on the north and on the east by being somewhat milder in climate. The growing season is long and sunny, and the summer is the hottest to be found in the Province.

The total area of possible agricultural land in the district is not large, and irrigation is absolutely required for all of it.

The soils, as throughout the entire Dry Belt, are usually alluvial in character, having been deposited on the floor of the great fresh-water lake which at some ancient period covered the entire Interior country to a depth of about 3,000 feet above sea-level, present elevation. The most characteristic feature of the agricultural lands of the Dry Belt is the bench or terrace formation, these benches lying from a few feet to several hundred feet above the present river or lake levels. The soils, as is common throughout all arid regions, are fertile, and on the whole well supplied with lime, potash, and phosphoric acid, and though they have but little humus or vegetable matter, yet their nitrogen is in a very available form.

The greater part of the district is within reach of the C.P.R. and C.N.P.R. main lines, so that, while the local market is small, there is an excellent outlet, both to the Coast and to the East, for all that is produced in the district. Freight rates on the whole are favourable, and the high quality of the product ensures a favourable market. At the present time railway-construction is consuming most of the vegetables and much of the fruit grown in the district, but normally long-distance shipments are made.

The district has two of the largest old orchards of the Interior—that of Mrs. Smith at Spence's Bridge, and that of Thos. G. Earl at Lytton. These orchards, with a number of smaller ones, have been producing very high-class fruit of many kinds for a number of years. The total acreage of trees in bearing is not very great, and there has not been enough agricultural land available to permit of much further planting, yet the district has one of the most favourable climates, if varieties are correctly chosen.

Strawberries—

Magoon.

Raspberries—

Herbert.

Cuthbert.

Red Currants—

Fay.

Victoria.

Gooseberries—

Oregon Champion.

Downing.

Industry.

Sour Cherries—

Montmorency.

Sweet Cherries—

Royal Anne

Bing

Lambert

Inclined to winter injury.

Grapes—

Concord

Delaware

Niagara

Worden

Are well proven here.

Plums and Prunes—

Peach Plum.

Bradshaw.

Pond's Seedling.

Italian Prune.

Reine Claude.

Crab-apples—

*Transcendent.

Hyslop.

Pears—

Bartlett.

Flemish Beauty.

Anjou.

Winter Nelis.

Apples—

Yellow Transparent.

Duchess.

Wealthy.

*McIntosh.

*Jonathan.

*Grimes Golden—Very good.

Northern Spy.

*Winesap—The best variety for planting here.

*Yellow Newtown.

(7.) KAMLOOPS-WALHACHIN DISTRICT.

The lands included in this district lie along the valley of the main Thompson River; the North Thompson for some distance north of Kamloops; and the East Thompson to a point beyond Ducks, on the main line of the C.P.R. to the east; at an elevation of 1,000 to 1,500 feet. The land in the district suitable for fruit-growing, under irrigation or irrigable, is only a small percentage of the entire area, and lies principally along the valleys of the rivers and the lower valleys of their tributary streams, where irrigation systems, either by gravity or pumping, can be installed.

The climate is typical of the Dry Belt, with a total precipitation of from 9 to 11 inches annually, evenly distributed throughout the year, the snowfall being, therefore, light and not of much significance. The air is dry and sunshine is plentiful and bright. In the winter there may be cold snaps, accompanied by wind, which prevent the cultivation of any but hardy varieties of fruit. The summer season is long and warm, bringing all varieties of fruit to a high colour and quality.

The soils are those of the Dry Belt described under the previous district, being usually deep, rich, and of good texture. Gravelly areas exist, and are not suitable for fruit-culture here as in any other section. There is, however, a large percentage of very good soil.

This district, having main line facilities, both on the C.P.R. and C.N.R., is well adapted to serve both the Coast and the Prairies, and has so far found a

ready market for all it has produced. In this district is grown the Ashcroft potato, which has a reputation all over Western Canada.

Fruit-growing in this district is looked on with favour, because of the generally high character of the soil, and the advantages of the summer climate for producing high colour and quality. Present production is not at all large, coming as it does from only a few old orchards planted around the establishments of the big cattle-ranches of a decade ago. These large ranches are being split up, where irrigation-water for their cultivable areas is to be had, into 10-, 15-, and 20-acre tracts for apple-culture. Plantings have been mostly along the lines of the varieties starred in the variety list recommended below, and these varieties are as a rule doing well. We do not recommend Spitzenberg or Yellow Newtown for this district, as occasional winters may be too severe for them.

This district will, in a few years, be one of the largest shippers of fruits and vegetables in the Province as the projects now under way become settled and planted.

Strawberries—

Magoon.

Raspberries—

Herbert.

Cuthbert.

Gooseberries—

Oregon Champion.

Downing.

Industry.

Red Currants—

Fay.

Victoria.

Sour Cherries—

Montmorency.

Sweet Cherries—

Reine Hortense.

Bing.

Plums and Prunes—

Peach Plum.

Bradshaw.

Pond's Seedling.

Italian.

Damson.

Reine Claude.

Crab-apples—

Transcendent.

Pears—

Bartlett.

Flemish Beauty.

Anjou.

Apples—

Yellow Transparent.

Duchess.

*Wealthy } The best two apples to plant.

*McIntosh }

Jonathan.

Grimes Golden.

Scott's Winter—Worthy of trial.

*Winesap—In part of the district is very good.

(8.) SOUTHERN CENTRAL PLATEAU.

In southern British Columbia there is a great deal of farming and ranching carried on at elevations of from 2,000 to 3,500 feet in a Dry Belt country having

from 10 to 18 inches annual precipitation. This includes the Nicola Valley, Grande Prairie, and similar valleys at similar elevations. The boundaries on the map show this area to lie entirely between the Okanagan Valley and the Cascades, south of the Thompson River. There are, however, Dry Belt areas at similar elevations farther east, and to some extent north of the Thompson River, where similar recommendations of fruit may apply.

In general character, the climate, which is dry, is sunny and cool. The records, which have been kept at only a very few points, show that summer frosts are not unknown, while winter freezes may occasionally be severe. Records at Nicola Lake, at an elevation of 2,120 feet, for twelve years, give a growing season extending from April 13th to October 20th, a total of 190 days. The mean temperature of the six hottest weeks is 61.1 degrees, and the mean annual temperature 42.1 degrees. Under such conditions, only short-season fruits are likely to do well, and due care should be taken to choose those which have a reasonable prospect of standing the winters. There is practically no commercial fruit-growing in this district, and it is not likely to prove remunerative in the strong competition furnished by the valleys at lower levels, with longer growing seasons and milder winters.

The soils are variable, but a great many of them are good. A great many of them, such as the volcanic ash, are entirely suitable for fruit-culture—of course, under irrigation. There is a home market in the territory at present much greater than local production, and this will continue to be the case for many years. At the same time, it is recognized that the fruit-growing in this district will be mainly in the line of building up a home orchard. There are but few orchards planted up to the present time, but as more is being learned about the climate, and as more care is taken to choose hardy varieties, it is certain that fruit-culture to some extent will be carried on quite successfully.

Many kinds of small fruits will, of course, do well, and will have good quality, and it may be that, with the transportation facilities to be given this territory by the new railways now building through parts of it, this industry may grow and develop.

The list of fruits recommended is as follows:—

Strawberries—

Magoon.

Raspberries—

Herbert.

Cuthbert.

Gooseberries—

Oregon Champion.

Red Currants—

Fay.

Victoria.

Black Currants—

Naples.

Sour Cherries—

Montmorency.

Dyehouse.

Sweet Cherries—

Vilne Sweet.

Plums and Prunes—

Wild Goose.

De Soto.

Lombard.

(Try varieties of Americana and Nigra types.)

Crab-apples—

Transcendent.

Martha.

Hyslop.

Pears—

Flemish Beauty.

Apples—

*Yellow Transparent

Red Astrachan

*Duchess

*Wealthy

*Alexander

Wolf River

*McIntosh

Fameuse.

Scott's Winter.

McMahon White.

} The starred varieties give a succession from
August to December for market.

(9.) SHUSWAP LAKE.

This comprises some areas which are not usually grouped, but the climatic conditions are such that development throughout the section is going on along about the same lines, and recommendations may be made for it accordingly.

The principal agricultural areas are those of Salmon Arm, Armstrong, Enderby, and Notch Hill. The land lies from 1,200 to 1,600 or 1,700 feet above sea-level, and from 15 to 500 or 600 above Shuswap Lake. Salmon Arm and Armstrong are old-settled communities, with a large production of fruits and vegetables.

This section is the most westerly of the Interior humid areas. The annual precipitation at Salmon Arm and Armstrong averages around 20 inches, which falls almost equally throughout the area, the greater part, however, in the six winter months, largely as snow. The winters are not cold, though there is some injury to the tenderer kinds of fruit. The summers are of good length, and warm, giving a very fine growing season for such varieties as Northern Spy, Grimes Golden, and McIntosh apples. The records show a growing season of 200 days at Salmon Arm, extending from April 6th to October 23rd, with a mean temperature in the six hottest weeks of 65.5 degrees, which is warm enough to permit of the development of corn and tomatoes.

While the total precipitation is not as great as might be desired for an exclusively non-irrigated district, no irrigation is being practised, and it must be said that as yet there are no crop failures recorded for this district because of drought.

The soils are much like those of the Dry Belt, save that under more humid conditions there has been some leaching of plant-food, while the growth of coniferous timber, which must be cleared, leaves the soil in a less favourable condition for cultivated plants for a year or two. Most of the upland soils are deep and retentive in character, and admirably adapted to a climate where as much moisture as possible must be conserved by cultivation throughout the growing season.

All parts of the district are within easy reach of the C.P.R. main line, and fruit-growers find a market both east and west for all that the district will not consume locally. Salmon Arm ships an average of from thirty to fifty car-loads of apples and larger quantities of produce annually, and Armstrong, though not a large shipper of apples, is the largest initial shipping-point in the entire Upper Country for potatoes, celery, cabbage, and other vegetables.

At Shuswap, Notch Hill, Salmon Arm, Seymour Arm, Mara, Enderby, Armstrong, and other points, there have been large plantings in recent years, principally to winter apples, and these are just beginning to come into bearing. Small fruits have proven satisfactory, especially at Salmon Arm, with its main-line facilities and progressive fruit-growers' organization. Spraying for apple-scab is necessary.

Because its climate in many respects resembles that of Ontario, the district is a popular one for certain classes of settlers, and is developing rapidly. The varieties planted, as a whole, are now being well chosen, though many miscellaneous and odd varieties planted in previous years have a depressing effect on prices received.

The list of fruits recommended for planting is as follows:—

Strawberry—

*Magoon.

Raspberry—

*Cuthbert.

Gooseberries—

Oregon Champion.

Downing.

Industry.

Red Currants—

Cherry.

Fay.

Sour Cherries—

Early Richmond.

Olivet.

Morello.

Sweet Cherries—

Royal Anne.

Bing.

Black Tartarian.

Plums and Prunes—

Bradshaw.

Yellow Egg.

Pond's Seedling.

Italian.

Reine Claude.

Crab-apples—

*Transcendent.

Hyslop.

Pears—

*Bartlett.

Clapp's Favourite.

*Flemish Beauty—Somewhat liable to scab here.

Anjou.

Apples—

Transparent.

Duchess.

*Wealthy.

Gravenstein.

*McIntosh—Apple-scab is a drawback.

Cox's Orange.

*Jonathan.

*Grimes Golden.

*Wagener.

*Northern Spy—Very highly considered.

(10.) UPPER OKANAGAN LAKE.

In this section are included Vernon, Kelowna, and the territory tributary to each. This has been for years the largest fruit-shipping district of the Province, and is likely to continue to hold that position for some years to come. The fruit-growing areas constitute quite a large proportion of the land included in the boundaries as marked on the map, and transportation facilities at present are by Okanagan Lake and the Shuswap and Okanagan branch of the C.P.R., which joins the main line at Sicamous. Fruit-growing is conducted at a considerable range of elevation above Okanagan Lake, which is at 1,200 feet, but practically all the commercial orchards are between 1,200 and 1,600 or 1,700 feet above sea-level.

In this district there is probably more land than in any other district of similar size in the entire Interior suitable for commercial fruit-growing. No figures are, however, available for either the amount of cultivated land or the amount of cultivable land here.

The climate may be taken as dry, usually warm in summer, and mild in winter. The total precipitation, as shown by carefully kept records at Vernon and Kelowna, is between 12 and 15 inches annually, of which slightly the greater half falls between October and March, inclusive. The snowfall is fairly reliable, though not deep, and furnishes sleighing for some months at levels of 1,500 feet or more, but is not constant or of much value on the lower levels. While the winter is usually bright and sunny, there are cold snaps, accompanied by wind, which affect peaches and the tenderer fruit-trees. Overirrigation and severe pruning have caused what are normally perfectly hardy varieties of apples to suffer as well, but in general there have been few mistakes made, and the fruit industry is in a very healthy condition.

In the growing season, which averages in length from April 5th to October 22nd, a total of 200 days, the average precipitation is about 7 inches, so that irrigation is necessary as soon as the orchard is planted. The mean temperature of the six hottest weeks is 66.3 degrees, indicating warm days, but reasonably cool nights.

What is said about soils in other Dry Belt districts is true here. There is a very large percentage of good fruit-growing soil in this section, and not many orchards have been planted in entirely unsuitable locations. It is advisable here, as everywhere else, for the intending fruit-grower to learn by personal observation what is the character of his soil and subsoil.

The district is well organized to supply its markets and to meet its competition, and for a number of years the growers have secured the full market returns for their produce. The greater part of the output is marketed in Alberta and Saskatchewan, but, with increased production, more and more is going to the Coast, which has been heretofore neglected in favour of the slightly higher-priced market to the East.

At the present time, Jonathan, McIntosh, Wealthy, Transcendent crab-apples, Wagener, and Italian prunes have been the principal fruits shipped, in quantity about in the order named.

The orchard survey conducted by the Department of Agriculture in the summer of 1911 showed the following plantings in the Vernon District:—

"In the area surveyed (3,188 $\frac{3}{4}$ acres) the fruit-trees planted totalled as follows:—

" Apples	223,615
Prunes	16,042
Pears	7,477
Peaches	2,120
Cherries	3,555
Plums	7,282
Apricots	80

The percentage of varieties of apples planted are as follows:—

" Summer and early fall	3.2 per cent.
Wealthy	9.1 "
McIntosh Red	9.3 "
Crab	9.0 "
King	0.3 "
Jonathan	21.2 "
Wagener	14.5 "
Grimes Golden	3.0 "
Northern Spy	2.5 "
Spitzenberg	2.2 "
Newtown Pippin	1.7 "
Other fall varieties	1.4 "
Other winter varieties	11.5 "

(This latter includes Snow, Greening, Sutton Beauty, Baldwin, Delicious, Canada Baldwin, etc.)

"Also—

"Jeffries	1.4 per cent.
Winesap	0.3 "
Cox's Orange	6.0 "
Rome Beauty	2.3 "
Red-cheeked Pippin	0.5 "
Salome	0.6 "

"The varieties of pears include Clapp's Favourite, Bartlett, Flemish Beauty, Clairgeau, and Winter Nelis, the most extensively planted being Bartlett and Flemish Beauty.

"Plums have produced well, the leading varieties being the Bradshaw, Washington, Peach, Pond's Seedling, Yellow Egg, Columbia, and Black Diamond.

"Italian prunes have also been extensively planted, with a lesser number of the sugar and German varieties, the average production being from three to five boxes per tree."

Cherries, small fruits, and grapes are planted to only a limited extent.

At Okanagan Centre, which is quite a young district, the total trees planted were 63,894, the following being the details:—

"Apples	43,363; estimated crop, 535 boxes.
Pears	9,898; " " "
Plums	50; " " "
Prunes	4,799; " " "
Peaches	640; " " "
Cherries	5,144; " " "

Varieties of Apples planted.

"Summer and early fall	11.4 per cent.
Wealthy	11.8 "
McIntosh	12.6 "
Crab	0.7 "
King	0.6 "
Jonathan	18.0 "
Wagener	15.6 "
Northern Spy	0.4 "
Spitzenberg	12.6 "
Newtown Pippin	1.8 "
Other winter varieties	14.5 per cent."

This district has a rather milder winter than Vernon.

In the area covered by our surveyor in Kelowna District the following trees were planted:—

"Apples	131,345
Pears	11,591
Plums	1,254
Prunes	8,830
Peaches	1,250
Apricots	135
Cherries	5,711

"The following are the percentages of the varieties planted:—

"Summer and early fall	1.0 per cent.
Wealthy	7.9 "
McIntosh Red	14.5 "
Crab	5.9 "
Jonathan	27.6 "
Wagener	7.2 "
Grimes Golden	1.0 "
Northern Spy	6.0 "
Spitzenberg	6.1 "

Newtown Pippin	7.0 per cent.
Other winter varieties	15.8 „
(The latter include Ben Davis, Cox's Orange, Winesap, Delicious, and Gravenstein, etc.).	

Westbank, which is on the west side of Okanagan Lake from Kelowna, is a comparatively new section, in which fruit-trees have been planted as follows:—

“ Apples	6,420
Pears	158
Plums	10
Prunes	133
Peaches	500
Apricots	187
Cherries	357

“ Varieties planted.

“ McIntosh Red	7.5 per cent.
Crabs	4.2 „
Jonathan	28.3 „
Wagener	20.7 „
Grimes Golden	8.3 „
Northern Spy	8.0 „
Newtown Pippin	5.0 „
Other winter varieties	5.4 „
Cox's Orange	3.2 „
Winesap	4.2 „
Rome Beauty	5.2 per cent.”

The information as to varieties planted in these districts, which is given above, is condensed from the Orchard Survey Report reproduced in the Twenty-second Annual Report of the British Columbia Fruit-growers' Association, which may be obtained from the Department on request.

It will be noted from the lists of varieties above that there has been a very general planting of miscellaneous varieties, even in these, the most advanced districts of the Province. The tendency towards a selection of the very best varieties is, however, preventing much further planting of miscellaneous kinds, and it is to be hoped that the recommendations below will have some influence in enabling growers to choose a limited list of commercial varieties.

Strawberries—

Magoon.

Raspberries—

Cuthbert.

Gooseberries—

Oregon Champion.

Downing.

Industry.

Red Currants—

Cherry.

Fay.

Black Currants—

Naples.

Sour Cherries—

Olivet.

Morello.

Sweet Cherries—

May Duke.

Royal Anne.

Tartarian.

Bing.

Plums and Prunes—

Peach Plum.
Bradshaw.
Yellow Egg.
Pond's Seedling.
Italian Prune.
Washington.
Shropshire Damson.

Grapes—

Moore's Early.
Concord.
Niagara.
Delaware.

Crab-apples—

Transcendent.

Pears—

*Flemish Beauty
*Bartlett
Howell
*Anjou
*Bosc
*Clairgeau

} Pears have done remarkably well on the lower lands at Kelowna, and this seems to warrant further planting.

Apples—

Transparent.
Duchess.
Wealthy.

*McIntosh.

*Jonathan.

*Wagener—Has been winter-injured to some extent.

*Grimes Golden.

*Rome Beauty.

Delicious—Worthy of extensive trial here.

Yellow Newtown—Worthy of further trial.

*Northern Spy—In certain locations.

(11.) LOWER OKANAGAN LAKE.

In this area are included the communities of Peachland, Summerland, Penticton, Naramata, and some smaller ones.

The climates at elevations of from 1,200 to 1,700 feet in the Lower Okanagan Lake District are rather milder, with longer growing seasons, than on the upper part of the lake, but there is every reason to believe that the benches of Kelowna, for instance, have practically as long and as favourable a growing season as have those of Summerland. There is no marked distinction, the general climatic conditions being more favourable in the south.

In proportion to the area ultimately available, this district has been more thoroughly developed in the past eight years than probably any other similar area in the Province. In Peachland, Summerland, and Penticton, nearly all of the possible land-area is under cultivation, and 75 per cent. of it is devoted to fruit. There will be, however, further plantings in this favoured district, and in every community there is a great deal of changing of poor varieties to better ones to be accomplished.

The climate is rather more arid than farther up the lake, the annual precipitation at Summerland and Penticton for a five years' record in each case showing about 10 inches precipitation, as against $12\frac{1}{2}$ at Kelowna and $14\frac{1}{2}$ at Vernon. The growing season lasts from April 3rd to about October 26th, and averages, therefore, around 206 days long. At the lake-level the season is ten days longer than on the benches 200 or 300 feet above it, and there are a few hundred more

heat units received, but the mean temperature of the six hottest weeks is about 2 degrees less, due to the cooling influence of the deep lake.

The precipitation is fairly evenly distributed during the four quarters of the year. Snowfall is, of course, light, though at an altitude of 300 to 400 feet above the lake it is of some use to supply moisture and to provide protection for tree-roots. All the land in this district under cultivation is of necessity under irrigation.

The soils are typically Dry Belt, and a big proportion of the area has deep volcanic ash and clay loam soils of considerable fertility. There are, however, considerable areas of open gravel on some of which fruit-growing is being attempted, with less success. In common with the upper half of the Okanagan Valley, the district finds its market on the Prairie and to some extent on the Coast, while this year, for the first time, a number of car-loads of apples are being sent to Great Britain direct.

In this district there was practically no fruit-growing being done up to about eight years ago, but four large irrigation systems made possible the planting of the present acreage. It is in this district that the great proportion of the British Columbia peach-crop is grown, and about one-third of the trees are peaches. As these are planted as fillers in the apple-orchards, the great majority must be removed in a few years at latest, and the district will then become to all intents and purposes a producer of winter apples. Only a small proportion of pears, plums, or other fruits has been planted.

The following figures, taken from the Orchard Survey of the Department of Agriculture, indicate the relative plantings of trees in the various sections:—

“Peachland District.”

“Apples	14,239
Pears	726
Plums	340
Prunes	48
Peaches	7,215
Apricots	125
Cherries	963

“Of the trees planted, 66.3 per cent. are over five years old, 33.7 per cent. being under five years. Peachland has planted less trees in proportion during the last five years than any other point on the Okanagan; the above represents practically the entire available acreage.

“The varieties are as follows:—

“Summer and early fall	2.8 per cent.
Wealthy	5.5 „
McIntosh Red	4.7 „
Crabs	3.1 „
King	0.7 „
Jonathan	18.7 per cent.
Wagener	17.0 „
Grimes Golden	1.4 „
Northern Spy	3.5 „
Spitzenberg	5.2 „
Newtown Pippin	2.3 „
Other winter varieties	35.1 „

(The latter are chiefly Bismarck, Snow, Ontario, Gravenstein, Baldwin, and Canada Red.)

“The varieties of peaches planted are Alexander, Triumph, Yellow St. John, Fitzgerald, Early and Late Crawfords, and Elberta.

“Pears are chiefly Bartlett and Flemish Beauty, and cherries Royal Anne, Bing, Governor Wood, Lambert, and English Morello.

"Summerland.

"An area of 1,497 acres, with 133 orchards, was inspected here. The following tables show numbers, etc.:—

" Apples	80,536
Pears	6,160
Plums	2,087
Prunes	999
Peaches	45,357
Apricots	4,648
Cherries	2,023

"Of the apples, 47.6 per cent. were found to be over five years old, and 52.4 per cent. five years and under.

"Varieties of Apples planted.

" Summer and early fall	0.8 per cent.
Wealthy	2.4 "
McIntosh Red	4.4 "
Crab	2.5 "
Kling	1.9 "
Jonathan	21.0 "
Wagener	18.5 "
Grimes Golden	2.4 "
Northern Spy	7.5 "
Spitzenberg	11.5 "
Newtown Pippin	13.4 "
Hubbardson's	1.3 "
Winesap	1.0 "
Baldwin	0.8 "
Winter Banana	0.8 "
Other winter varieties	9.8 "
(The latter include Rome Beauty, Delicious, Snow, etc.)	

"Bartlett and Flemish Beauty pears are the leading favourites, with Beurre d'Anjou, Clapp's Favourite, Duchess, and Comice. The leading varieties of plums are Pond's Seedling, Coe's Golden, Yellow Egg, Burbank, and Italian Prune.

"Penticton.

"Details were obtained of 102 orchards in this district, with an area of 1,158 acres, the following being the number of trees planted, etc.:—

" Apples	43,274
Pears	3,866
Plums	1,418
Prunes	1,502
Apricots	1,879
Cherries	3,030

"Total trees planted, 97,877, 93.6 per cent. of which were five years old and under, and 6.4 per cent. over five years old.

"The varieties of apples planted were as follows:—

" McIntosh Red	5.5 per cent.
Jonathan	32.0 "
Wagener	21.6 "
Grimes Golden	2.6 "
Spitzenberg	12.3 "
Newtown Pippin	7.0 "
Other winter varieties	19.0 "
(The latter include Winesap, Rome Beauty, and Delicious, about equal proportions.)	

"The main plantings of peaches include Triumph, Yellow St. John, Fitzgerald, Early and Late Crawford, and Elberta.

"Naramata District.

"Sixty-five orchards, with an area of 557 acres, were accounted for here, with a total of 39,359 fruit-trees planted.

"The following tables show varieties planted, etc.:—

" Apples	20,569
Pears	1,972
Plums	689
Prunes	120
Peaches	11,456
Apricots	3,661
Cherries	894

"Percentage of Varieties.

" McIntosh Red	3.4 per cent.
Jonathan	30.2 "
Wagener	19.6 "
Spitzenberg	10.0 "
Newtown Pippin	12.6 "
Rome Beauty	7.8 "
Winesap	4.4 "
Delicious	2.2 "
Winter Banana	4.6 "
Other winter varieties	5.2 per cent."

The varieties recommended for Southern Okanagan Lake are as follows:—

Strawberries—

Glen Mary.

Dunlop.

Raspberry—

Cuthbert.

Gooseberries—

Oregon Champion.

Downing.

Industry.

Blackberries—

Snyder

Agawam

} Liable to freezing.

Red Currants—

Cherry.

Fay.

Black Currants—

Naples.

Sour Cherries—

Olivet.

Morello.

Sweet Cherries—

Royal Anne.

Bing.

Tartarian.

Peaches—

Triumph

Hale's Early

Yellow St. John

Elberta

} A list for home use and canning.

Apricots—

Moorpark.

Blenheim.

Apricots—

Tilton.
Royal.

Grapes—

Moore's Early.
Campbell's Early.
Concord.
Niagara.
Delaware.

European varieties produce well, if protected.

Plums and Prunes—

Peach.
Bradshaw.
Yellow Egg.
Pond's Seedling.
Italian Prune.
Reine Claude.
Damson.

Crab-apples—

Transcendent.
Hyslop.

Pears—

Flemish Beauty.
Bartlett.
Anjou.
Clairgeau.
Winter Nellis.
Howell.

Apples—

Yellow Transparent.
Duchess.
Wealthy.
*McIntosh.
*Jonathan.
*Grimes Golden.
*Wagener.
*Rome Beauty.

Delicious	} May prove of highest class commercially on further trial.
Yellow Newtown	

(12.) SIMILKAMEEN.

In this district are included the lower valley of the Similkameen (extending up to a few miles above the town of Keremeos, which is the principal fruit centre of this section) down to the point where the river crosses the boundary into the United States, and the valley of the Lower Okanagan River and Osoyoos Lake. Of this district, no meteorological records have been kept, but practical experience has shown it to have a longer and warmer season than any other part of British Columbia, and so it is adapted to certain varieties of fruit which require such a long season, such as the Winesap apple.

There are several thousand acres of land now under irrigation, and on some of this has already been planted fruit-trees. Much larger areas of very fine land will undoubtedly be put under irrigation in the near future, and this, when accomplished, will make the district an important one.

As to climate, no definite figures can be offered, but the winters are usually mild, with little snow, and sunny. The growing season is long, practically free from spring or fall frosts, and warm.

The district has previously suffered from lack of transportation facilities, having only the Great Northern Railway, which made it tributary to Spokane. Direct

railway connections with Vancouver, now under construction, put the district in a very favourable position for the production of all kinds of early vegetables and many kinds of fruits for that market.

An idea of the present state of production and the plantings already made is given from the following quotations from our Orchard Survey:—

“Twenty-six orchards, with an area of 572½ acres, were visited here, fruit-trees being planted as follows:—

“ Apples	30,841
Pears	709
Plums	600
Prunes	76
Peaches	7,126
Apricots	166
Cherries	326

“Of the apple-trees planted, 76 per cent. were five years old and under, and 24 per cent. over five years old. The varieties are:—

“ McIntosh Red	13.7 per cent.
Jonathan	38.5 ”
Wagener	2.8 ”
Spitzenberg	13.7 ”
Newtown	7.0 ”
Baldwin	7.1 ”
Other winter varieties	17.1 ”
(The latter include Winesap, Yellow Belleflower, and Delicious.)”	

The section on the Okanagan River and Osoyoos Lake is very well described in the following paragraphs from our report on Orchard Survey:—

“*Fairview District.*

“From here to the boundary, a distance of twelve miles is a very large area of bench land lying west of the Okanagan River and Osoyoos Lake, at an elevation of 900 to 1,400 feet. The land suitable for fruit-trees is estimated at a minimum of 20,000 acres, the soil throughout being a deep sandy loam with volcanic ash, and the climate one of the driest in British Columbia. The precipitation for the last twelve months (rain and snow) was 5 inches, with minimum temperatures on January 12th and 13th, 1911, of -12 degrees, and on February 2nd, -3 degrees.

“There are only two orchards in this great area, the Park Ranching Co. (25 acres) and Leslie Hill's (36 acres), the reason being the lack of irrigation-water.”

The list of fruits recommended for the district is as follows:—

Strawberries—

Magoon.

Glen Mary.

Dunlop.

Raspberry—

Cuthbert.

Gooseberries—

Oregon Champion.

Downing.

Industry.

Blackberries—

Snyder.

Agawam.

Red Currants—

Cherry.

Fay.

Black Currants—

Naples.

- Sour Cherries—
 Olivet.
 Morello.
- Sweet Cherries—
 Royal Anne.
 Bing.
 Tartarian.
- Peaches—
 Hale's Early.
 Triumph.
 Yellow St. John.
 Elberta.
- Apricots—
 Moorpark.
 Blenheim.
 Tilton.
 Royal.
- Grapes—
 Moore's Early.
 Campbell's Early.
 Concord.
 Niagara.
 Delaware.
 European kinds, such as Black Hamburg and Flame Tokay, have been produced here for a number of years.
- Plums and Prunes—
 Peach.
 Bradshaw.
 Yellow Egg.
 Pond's Seedling.
 Italian Prune.
 Greengage.
 Shropshire Damson.
- Pears—
 Flemish Beauty.
 Bartlett.
 Anjou.
 Clairgeau.
 Winter Nelis.
- Crab-apples—
 Transcendent.
 Hyslop.
- Apples—
 Transparent.
 Duchess.
 Wealthy.
 McIntosh.
 *Jonathan.
 Grimes Golden.
 *Wagener.
 *Delicious.
 *Yellow Newtown.
 *Winesap—Especially valuable.

(13.) KETTLE RIVER VALLEY.

Of the large area marked out on the map as included in this section, there is, properly speaking, only a small percentage of land suitable for fruit-growing.

and it lies at an elevation of from 1,700 to 2,000 feet, between Rock Creek on the west and Cascade on the east, the International Boundary on the south, and extending into the small valleys north of the railways a short distance.

In general climate the district is not unlike that of the Northern Okanagan, both in summer and in winter, the particular conditions being much the same, save that in "the boundary" the snowfall is not so heavy. The winter temperatures are about the same as Vernon, and low temperatures make the tenderer varieties of fruit impracticable. Midway has the reputation of having a colder winter than Grand Forks, due to the configuration of the valley and its slightly greater altitude. At Rock Creek, which lies at about 2,000 feet, the snowfall is rather heavier, and it is probable that the total precipitation is considerably greater.

The soils of this district, which is in the Dry Belt, are not unlike those of the other Dry Belt districts above described. At Rock Creek there is a considerable proportion of light and open soils, especially on the bottom lands, while on the benches it is usually a black loam. At Midway the soil is a light to sandy loam, and varies a good deal at different elevations, while in the Grand Forks District there is a great deal of rich black loam on the lower levels, with sandy clay subsoil, and some good moderate clay loams on the benches, which lie at heights of from 40 to 100 feet above the river.

The orchards of this district find a market nearly altogether in the mining towns of the Boundary, the Kootenay, and the Crowsnest, but increased quantities are reaching the Prairie, while Grand Forks apples sent to Australia have given good satisfaction. The district is well situated with regard to freight rates locally and to the Prairies, but the long haul to the Coast results in a higher rate that way, and the transfers in moving the fruit out in any direction at present result in some delay. The completion of the Kettle Valley line to the Coast will be of the greatest assistance to this district in providing for it an additional outlet.

Fruit-growing commenced to develop at Grand Forks quite a number of years ago, this district being the site of the Hon. Martin Burrell's ranch and the Covert Estate. The survey reports given below indicate the development of the fruit industry in the principal areas included in this valley:—

"Rock Creek District.

"Eighteen orchards, with an area of 406½ acres, were inspected here. Of these, five were not irrigated and two only partially irrigated.

"The following tables show numbers planted, etc.:—

"Apples	16,088
Pears	280
Plums	36
Prunes	288
Apricots	250
Cherries	20

"Varieties of Apples.

"Wealthy	25.8 per cent.
McIntosh Red	24.6 "
Crab	5.4 "
Jonathan	25.4 "
Other winter varieties	18.8 "
(The latter include Delicious, Winter Banana, and Wismer's Dessert.)	

"Midway District.

"Nine orchards, with an area of 174½ acres, were visited here, with trees planted as follows:—

"Apples	8,394
Pears	55

Plums	65
Prunes	138
Cherries	30

"Varieties.

"Summer and early fall	4.2 per cent.
Wealthy	40.4 "
McIntosh Red	15.5 "
Jonathan	10.8 "
Wagener	12.5 "
Other winter varieties	16.6 "

(The latter include Ben Davis, Winter Banana, and Wolf River.)

"Of the apples planted, 32.2 per cent. are over five years old, and 67.8 per cent. five years old and under.

"Grand Forks District.

"Forty-one orchards, with an area of 1,696½ acres, were visited here.

"Trees planted.

"Apples	82,213
Pears	6,645
Plums	1,971
Prunes	7,488
Peaches	177
Apricots	300
Cherries	1,426

"Apple Varieties.

"Summer and early fall	1.5 per cent.
Wealthy	3.8 "
McIntosh Red	2.6 "
Jonathan	21.4 "
Wagener	20.4 "
Northern Spy	11.1 "
Spitzenberg	4.9 "
Newtown	5.6 "
Rome Beauty	2.9 "
Delicious	4.5 "
Winesap	3.2 "
Red-cheek Pippin	2.2 "
Other winter varieties	15.9 "

"Of the above apples, 12.9 per cent. are from five to fourteen years old, and 87.1 per cent. five years old and under."

The list of varieties recommended for this district is as follows:—

Strawberries—

Magoon.
Clark's Seedling.
Dunlop.
Royal Sovereign.

Raspberries—

Cuthbert.
Herbert.

Gooseberries—

Oregon Champion.
Downing.
Industry.

Red Currants—
 Cherry.
 Fay.
 Sour Cherries—
 Montmorency.
 Morello.
 Sweet Cherries—
 Royal Anne.
 Bing.
 Grapes—
 Moore's Early.
 Campbell's Early.
 Concord.
 Plums and Prunes—
 Peach.
 Bradshaw.
 Pond's Seedling.
 Shropshire Damson.
 Reine Claude.
 Crab-apples—
 Transcendent.
 Hyslop.
 Pears—
 Bartlett.
 Flemish Beauty.
 Clairgeau.
 Anjou.
 Apples—
 Yellow Transparent.
 Duchess.
 Wealthy.
 *McIntosh.
 Alexander.
 *Jonathan.
 Grimes Golden.
 *Rome Beauty.
 *Red-cheeked Pippin.
 *Ontario.
 Northern Spy.

(14.) WEST KOOTENAY.

For this district, we have grouped the large area tributary to the Arrow Lakes, the Lower Columbia River, Slocan Lake, Lower Kootenay River, Kootenay Lake, and the West Arm of Kootenay Lake. In the large area included there is only a very small proportion of land which is, or can be, cultivated and rendered suitable for fruit-growing, the principal areas being indicated by the survey reports given below.

The whole of the district is characterized by a total precipitation of from 28 to 42 inches annually, being lowest in the southern and south-westerly section, and increasing to its maximum at Revelstoke and the upper end of Kootenay Lake. The winter snowfall is usually heavy, and remains on the ground for a long period. Of the total precipitation, nearly two-thirds falls in the months of October to March, inclusive, partly as snowfall; but in the month of June the precipitation amounts to 2½ inches on the average, the humid condition then resulting giving rise to a certain amount of apple-scab, which has to be combated by spraying.

The growing season is longest at Nelson, Creston, and the more southerly points. In Nelson, for which good records are available, it extends on the average from April 3rd to October 22nd, a total of 202 days, while the mean temperature of the six hottest weeks is 65.0 degrees. At Revelstoke, with an altitude of 1,476 feet, as

against 1,760 feet at Nelson, the growing season is from April 16th to October 15th, a total of 182 days, with a mean temperature for the six hottest weeks of 63.3 degrees. Creston probably has a warmer and longer season than Nelson. As a general rule, it might be stated that the season is shorter and cooler, between the limits mentioned for Nelson and Revelstoke, as one goes north.

The climate in general is very like that of some parts of Ontario, save that West Kootenay is remarkable for its absence of winter injury in any form.

The soils are extremely variable, but in a great proportion they are light and deficient in most of the elements of plant-food. On the other hand, there is some very fine soil, and here, as elsewhere, much depends on the land selected.

While the district has been known for a number of years as a great mining country, its development in fruit-growing is of comparatively recent origin, and at the present time is just beginning to overtake local consumption of the mining and lumbering communities in most lines of fruit. In a few years, however, shipments to the outside must become larger and larger, especially in many varieties of apples which are produced here to a very high degree of perfection, and which will always command the favour of the market. The district is favoured in its location and its freight rates to the Prairie, while a new line being constructed to Vancouver will, it is expected, result in material improvement in service and in rates to the Coast. The scattered character of the settlements, and the use of water rather than rail transportation, result in a relatively higher cost of living and of production, which may be said to be offset by the very satisfactory quality of the fruit.

The varieties of fruit planted will be definitely dealt with in the 1912 Orchard Survey Report, now being compiled in the offices of the Department. It might be said at this time that peaches have been but very little planted, practically not at all commercially. The same is true of apricots and grapes. Pears, crab-apples, plums, and prunes have been planted to a small extent, sweet cherries rather more so. Strawberries have been put in in considerable acreage, especially by the Doukhobor Society. The principal fruit-plantings are of winter apples, principally Wagener, Jonathan, Northern Spy, McIntosh, Ontario, Cox's Orange, Wealthy, King, Gravenstein, Rome Beauty, and Delicious.

Generally speaking, conditions in this district are not favourable to the shipment of soft fruits, except for such points as have quick rail facilities east or west. Jam-making is now a well-established industry, and much more than the present production could be used for this purpose. The great future for this country in fruit-growing is undoubtedly in such varieties of winter apples as reach perfection.

The list of fruits recommended for planting are as follows:—

Strawberries—

Magoon	}	For shipping.
Dunlop		
Royal Sovereign		
Glen Mary	}	For canning.
William Belt		

Raspberries—

Cuthbert.

Gooseberries—

- Oregon Champion.
- Downing.
- Industry.

Red Currants—

- Cherry.
- Fay.

Black Currants—

Naples.

Sour Cherries—

- Olivet.
- Morello, English.
- Early Richmond.

- Sour Cherries—
 - Montmorency.
- Sweet Cherries—
 - Royal Anne.
 - Bing.
 - Lambert.
 - Black Tartarian.
- Peaches—
 - Alexander
 - Triumph
 - Early Crawford
 } Peaches must have warm location.
- Grapes—
 - Moore's Early
 - Campbell's Early
 - Concord
 } Must have favourable location.
- Plums and Prunes—
 - Peach.
 - Bradshaw.
 - Pond's Seedling.
 - *Italian Prune.
 - Reine Claude.
 - Shropshire Damson.
- Pears—
 - Bartlett.
 - Flemish Beauty—Scabs somewhat; requires careful spraying.
 - Clairgeau.
 - Anjou.
- Crab-apples—
 - Transcendent.
- Apples—
 - Yellow Transparent.
 - Duchess.
 - Wealthy.
 - Alexander—Fall cooking.
 - *McIntosh Red—Must be sprayed for apple-scab.
 - *Gravenstein—Of exceptional quality here.
 - Jonathan—Must have a warm sunny location and deep soil.
 - *Northern Spy—In warmer sections; with deep and rich soils.
 - *Wagener—The favourite apple; plant on benches.
 - *Ontario—Does very well.
 - Baldwin—Yields heavily.
 - Cox's Orange—Of good quality and keeps well.

(15.) EAST KOOTENAY.

This territory includes the valleys of the Upper Columbia and the Upper Kootenay, embracing a large area of agricultural land estimated at approximately 1,000,000 acres, most of which is available for mixed farming, by dry-farming methods without irrigation. The territory stretches from the International Boundary north-west through the Cranbrook and Windermere country, up to and including the Golden section.

The climate of the district is semi-humid in character, the total annual precipitation averaging about 16 to 19 inches, of which a considerable proportion falls in the second quarter of the year, at least in the southern half of the district. The records for Golden, Cranbrook, and Wilmer indicate a growing season of between 175 and 190 days, the most favourable records being from the Windermere country. The number of heat units runs from 9,250 at Golden to 10,000 at Cranbrook, 10,750 at Wilmer, and 10,750 at Tobacco Plains, in the Elko District. Similarly, the mean temperature of the six hottest weeks is 60.1 degrees at Golden, 62.2 degrees at

Cranbrook, 63.8 degrees at Wilmer, and 63.9 degrees at Tobacco Plains. The growing season is therefore short and cool, and this, by diminishing the amount of evaporation, helps to make more useful the amount of precipitation received. Dry-farming methods are producing very satisfactory crops of potatoes in the St. Mary's District, near Cranbrook, while alfalfa is being produced, mainly with supplementary irrigation, throughout the entire territory in small areas at the present time. Winter temperatures run sufficiently low to make the growing of most varieties of apples more or less unsatisfactory, and only the hardy varieties, which should do best in this district, are recommended by the Department.

The district is one which will eventually support a large population, based on mixed farming, with fruit-growing more or less as a side-line, as its possibilities become demonstrated. There is no reason why small-fruit culture should not obtain considerable success.

The soils are variable, but, the precipitation being light, they have not been leached of their valuable plant-food, and analyses made at the Central Experimental Farm, confirmed by practical farming experience in the district, show a very satisfactory supply of potash and lime, with variable amounts of phosphoric acid, and, as is usual in Dry Belt soil, a low content of nitrogen, in, however, a very available form. Much of the soil is a very fine, deep, rich loamy silt, and there are, of course, all extremes.

Most of the land carries a small growth of timber, which costs at present prices \$30 to \$50 per acre to clear. Irrigation is being applied on several large projects, especially in the more arid part of the Upper Columbia District, and settlement is proceeding most rapidly in these areas.

Up to a few years ago, the district was largely used as range land by a few large cattle-ranches, and thousands of cattle were exported yearly over the Crowsnest line and the C.P.R. main line. With the development of mining in the Crowsnest, and lumbering through the territory wherever railway facilities were sufficient, a local market has been gradually created for practically everything that is produced. The district has not been developed far enough to undertake to look after outside markets in any lines. There is no doubt that small fruits from the upper part of the district will be marketed in the Prairies in a few years, and should bring very good prices. Alfalfa is doing well, and the country has all the requirements for a successful dairying and mixed-farming industry. Practically no fruit-growing is being done outside of a very few small orchards here and there, principally of the earlier and hardier varieties, the fruit of which keeps exceptionally well owing to the short and cool season, and is marketed at very remunerative prices locally.

The following list of fruits recommended by this Department has in view hardiness and adaptability to conditions:—

Strawberries—

Bederwood.

Dunlop.

Williams.

Raspberries—

Herbert.

Red Currants—

Victoria.

Red Dutch.

Black Currants—

Saunders.

Victoria.

Gooseberries—

Oregon Champion.

Sour Cherries—

Early Richmond.

Montmorency.

Sweet Cherries—

Reine Hortense.

Vilne Sweet.

Plums and Prunes—

Wolf.

Hawkeye.

Stoddard.

De Soto.

Cheney.

Also other American plums. Try also Shropshire Damson and Reine Claude.

Crab-apples—

Whitney.

Martha.

Transcendent.

Pears—

Flemish Beauty.

Apples—

Yellow Transparent.

Charmaloff.

Tetofsky.

Duchess.

Wealthy.

McMahon White.

Longfield.

McIntosh Red } Worthy of trial.

Scott's Winter }

Milwaukee.

North-west Greening.

(16.) CENTRAL BRITISH COLUMBIA.

Outside of the areas described under previous headings as the fruit districts of southern British Columbia, there remains the greater part of the possible agricultural area of the Province which falls east of the Cascade Mountains and north of the main line of the Canadian Pacific Railway. Through this country the main lines of the Canadian Northern and the Grand Trunk Pacific will run, and here it is that tremendous agricultural development will undoubtedly take place in the near future. All authorities who have visited this great and hitherto unknown country unite in according it a great future in mixed farming and general agriculture. On account of the character of the growing season, which is inclined to be somewhat short and cool, with occasional summer frosts, together with winter temperatures, that will prove too severe for most of the commercial varieties of fruit, the district is not expected to become one for commercial fruit-production. There will, of course, always be a ready local market for whatever fruit is produced, but the principal function fruit-growing will have will be that of providing something for the farmer's home.

This great area includes those valleys of the north which are now so much in the public eye, including the Upper Skeena, the Upper Fraser, the Bulkley, Stewart, the Nechaco, and all the territory described now as the Fort George country.

The reports in the hands of the Department of Agriculture would indicate that while the soils throughout this country are variable, as in the rest of the Province, yet there is a large proportion of good agricultural land which will be quite suitable for experimental work with fruit. Up to the present time there have not been brought to the attention of the Department any fruit-trees farther north than Soda Creek and Quesnel in the Fraser basin, except some which have been planted in the last two years. We believe that, with the choice of the hardier

varieties, home orchards could be made quite general through the entire area, the winter climate being but little more severe than that of Ottawa.

The Department of Agriculture has distributed a number of trees for experimental purposes in this district, and more will be known in a few years about its capabilities. In the meantime, the following list of varieties is submitted as containing those most worthy of trial:—

Strawberries—

Bederwood.

Dunlop.

Williams.

Raspberries—

Herbert.

Red Currants—

Victoria.

Red Dutch.

Black Currants—

Saunders.

Victoria.

Gooseberries—

Oregon Champion.

Sour Cherries—

Early Richmond.

Montmorency.

Orel 25.

Plums and Prunes—

Wolf.

Hawkeye.

Stoddard.

De Soto.

Cheney.

Also other American plums. Try also Shropshire Damson and Reine Claude.

Crab-apples—

Whitney.

Martha.

Transcendent.

Pears—

Flemish Beauty.

Apples—

Yellow Transparent.

Charmaloff.

Tetofsky.

Duchess.

Wealthy.

McMahon White.

Longfield.

McIntosh Red.

Scott's Winter.

Milwaukee.

North-west Greening.

GENERAL SUGGESTIONS TO ORCHARD-PLANTERS.

All fruit-trees sold in this Province are inspected by the Inspector of Fruit Pests' Branch of the Department of Agriculture. They may be accepted as practically free from all insect pests, and are not likely to show any fungous or bacterial disease at a later date; as far as inspection can render them clean, they are so. In addition, all the nurserymen of this Province, and all the nurserymen outside the

Province who have agents in the Province, are licensed, and bonded in the sum of \$2,000 each, as indicated in the following excerpts from the "Agricultural Associations Act":—

"60. No person shall sell within the Province, as principal, agent, solicitor, or otherwise, fruit-trees, plants, or nursery stock without the licence therefor by this Act required.

"61. Any person may obtain from the Minister a licence to sell within the Province fruit-trees, plants, and nursery stock upon payment of the licence fee hereinafter provided, and upon filing with the said Minister a bond to His Majesty, satisfactory to said Minister, in a penal sum not exceeding two thousand dollars, conditional that the obligor shall pay all damages that may be occasioned to any person in the Province through the sale to such person by the licensee, his agent or agents, of any infected fruit-trees, plants, or nursery stock, or of any fruit-trees, plants, or nursery stock that are not of the variety and character represented by the licensee, his agent or agents, at the time of sale.

"62. Any person in this Province who shall sustain damage through the sale to him by the licensee, his agent, or agents, of any infected fruit-trees, plants, or nursery stock, or of any fruit-trees, plants, or nursery stock that are not of the variety and character represented by the licensee, his agent or agents, at the time of sale, shall have a right of action in the Courts of this Province upon said bond for such damages, notwithstanding the provisions of any contract of agreement to the contrary.

"63. A licence under section 61 hereof shall not be for a longer period than one year, and shall expire on the thirty-first day of December of the year in which it is issued.

"64. The fee for such a licence shall be five dollars for nurserymen and five dollars for each agent.

"65. Any licence granted under the foregoing sections may be suspended or cancelled by the Minister, upon evidence satisfactory to the Minister that the holder of the licence has sold infected fruit-trees, plants, or nursery stock, or fruit-trees, plants, or nursery stock that were not of the variety or character represented at the time of sale."

This Act has been passed for your protection. It is, however, necessary for you to read it carefully and understand it in order to obtain the benefits which it confers.

Some nursery stock is sold here by mail. Legally, no protection can be afforded the purchaser who sends his money out of the Province in a mail order, and on this account it is wiser to avoid those nurserymen who refuse to put up bonds and do business through agents.

A list of the principal firms growing nursery stock in British Columbia is as follows:—

Vancouver Island.—The Layritz Nurseries, Victoria; Vancouver Island Nurseries, Somenos; G. A. Knight, Mt. Tolmie.

Lower Mainland.—Fraser Valley Nurseries, Aldergrove

Interior.—Coldstream Nurseries, Vernon; Layritz Nurseries, Kelowna; Riverside Nurseries, Grand Forks.

Buy from reliable, established, and responsible firms. Buy only stock which has been grown by the nurserymen who sells it to you. There is a double risk in buying from the nursery-stock jobber, and there have been more unsatisfactory results from stock so purchased than from stock bought direct from the nursery which grows it.

You are recommended to purchase stock grown under similar conditions of soil and climate. Coast-grown stock, generally speaking, does better on the Coast, and Dry Belt stock better in the Dry Belt. There are plenty of exceptions to this general rule, but the principle stands.

In buying in British Columbia you get the trees quicker, and at lower costs for freight and other charges; you avoid inspection, and possible fumigation, at

Vancouver, to which all imported stock is subjected; and we are able to state that British Columbia stock is liable to be more free from pests than most of that grown in districts not so well protected from injurious insects.

It is well to place orders early in September rather than in December. For planting on Vancouver Island or in the West Kootenay, which it is desirable to do in the fall, orders may be placed still earlier, and the stock delivered late in October.

In buying from agents, remember that the accredited agent will have his licence to show. Keep a copy of the order given and insist on the delivery of the varieties you specify. It is better to make a personal inspection of the stock at the nursery, and one man might very well do this for himself and a number of neighbours at the same time. In such case stock should be inspected before it is dug and stored.

SELECTION OF NURSERY STOCK.

It is now generally agreed that the one-year-old tree has such great advantages as to be most desirable for nearly all conditions. For fall planting in the Lower Mainland a two-year-old tree may be better, and for most types of cherries, in any Coast section, the two-year or even the three-year-old tree may stand transplanting to better advantage than the one-year-old. As a general rule, however, the one-year-old top on either a two- or three-year-old root is satisfactory. For home orchard use, a two- or three-year-old tree may be brought into bearing earlier, and will make a dwarfer tree.

The type of the stock selected is of importance. For all parts of the Interior it is a great mistake to plant trees which grew 5, 6, or 7 feet high in the nursery. The best stock is $3\frac{1}{2}$ to $4\frac{1}{2}$ feet high, one year old. This can then be headed at 20 to 24 inches to very good advantage. There is a tendency on the part of inexperienced growers to purchase big trees. In fact, the nurserymen claim that they insist on having the big stock. The results are usually much less satisfactory than with smaller, well-matured stock, in many ways.

There is much discussion as to the relative merits of grafted or budded trees in the purchase of apples and pears. There is a great deal to be said on both sides, but the net results of the discussion are about evenly balanced.

Pests and diseases are rare on British Columbia grown stock, first because it is inspected regularly; second, because it is grown in districts naturally free from pests; and, third, because the whole of the stock is dug up each fall and sold out. With two- or three-year-old stock there is a chance for pests to accumulate.

The trees as delivered should be in good health, as shown by the healthy appearance of the bark. They should be well matured and with good strong buds. The root systems should be large, roots numerous, and with plenty of fibrous roots. The side shoots on the trunks of the trees should not have been removed, or at least enough of them should be left to form a head at the proper height.

CARE OF TREES ON ARRIVAL.

Nursery stock should be removed from the railway-station promptly on advice from the railway agent; it should be taken out to the place where it is to be planted, and if not to be planted immediately, then should be heeled in. If frozen in transit, the packages should be placed in a cool, shady spot, and allowed to thaw out very gradually. If the stock is dried out, it should be covered with moist soil pretty well up to the tops of the trees, instead of heeling in just to the depth the trees were in the nursery, as is usually to be done. If growth has started, the trees must be very carefully handled, and should be shaded after being unpacked, so as to save the new shoots if possible; if growth has started very materially, success is not very likely. In heeling-in in the fall, trees should be placed on a slant in a trench, about 10 inches deep, with the roots well covered with moist earth, which should be shaken down well among them. The tops of the trees should face towards the south to prevent sun-scald. In severe climates some

evergreen boughs may be thrown over the trees for protection. The place to heel in should be high and well drained and protected from mice.

PLANTING.

For the greater part of the Province, planting should be done in the spring, as indicated above. Fall planting may be done up to about November 1st with safety in the Kootenay, and about the middle of November on Vancouver Island. The time for planting in the spring is determined very largely by the amount to be done, the preparation of the land, and the men available, but it is best done as early as possible after heavy frosts are over. The holes should be large and dug early. Good soil should be placed in the bottom. The roots should be pruned so as to give good healthy wood at the tips of all the main roots. The tops should be headed back to from 20 to 24 inches. The trees should be protected from drying out by having the roots wrapped in a wet burlap sack, or by being carried in a packing-case, the bottom of which is filled with wet moss or wet bags, with which the roots are also covered.

The trees should be set very firmly and should be immediately irrigated if the soil is dry, but the irrigation should not touch the trunk of the tree. In planting on the Coast the tree should be set a little deeper than it was set in the nursery, up to about 2 inches deeper in open or sandy soils. In the Dry Belt they may be set from 2½ to 4 inches deeper, depending on the soil-texture and character of the subsoil. In the humid regions of the Interior they should be set on an average 2 to 3 inches deeper than in the nursery.

Our nurserymen as a rule pack their trees carefully, and with due regard to the time they will be in transportation, so that usually stock arrives in good condition. A great deal more damage is done to young trees by carelessness in handling and planting, especially by drying out, than can be readily believed. The greatest possible care to prevent drying out, to keep the trees vigorous, and to prevent loss of vitality in any way is the best possible insurance for a vigorous start.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1913.

DEPARTMENT OF AGRICULTURE.
 VICTORIA.
 Hon. Price Ellison, Minister.

MAP OF THE PROVINCE OF
 BRITISH COLUMBIA,
 Showing Districts for which Lists of
 VARIETIES OF FRUIT
 are
 RECOMMENDED.
 1913.

COLL. OF AGRICULTURE
PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF AGRICULTURE

BULLETIN No. 52

ANNUAL REPORT

—OF—

ADVISORY BOARD OF WOMEN'S INSTITUTE

Printed by Authority of the Legislative Assembly

VICTORIA, B. C.

PRINTED BY WILLIAM H. CULLIN, PRINTER TO THE KING'S
MOST EXCELLENT MAJESTY

1913

PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF AGRICULTURE

BULLETIN No. 52

ANNUAL REPORT

OF

ADVISORY BOARD OF WOMEN'S INSTITUTE

Printed by Authority of the Legislative Assembly

VICTORIA, B. C.

PRINTED BY WILLIAM H. CULLIN, PRINTER TO THE KING'S
MOST EXCELLENT MAJESTY

1913

Department of Agriculture,

Victoria, B.C., March 18th, 1913.

Hon. Price Ellison,

Minister of Agriculture.

Sir:—I have the honour to transmit herewith Bulletin No. 52, being the Annual Report of the Advisory Board of Women's Institutes in British Columbia for the year ending August 31st, 1912.

I have the honour to be, Sir,

Your obedient servant,

W. E. SCOTT,

Deputy Minister of Agriculture and Superintendent of Institutes.

MEMBERS OF THE ADVISORY BOARD.

Hon. Price Ellison, Minister of Agriculture, Victoria.

Wm. E. Scott, Deputy Minister of Agriculture, Victoria.

Mrs. W. V. Davies, Chilliwack. President.

Mrs. R. L. Lipsett, Summerland.

Mrs. J. F. Kilby, Nelson.

Mrs. A. T. Watt, William Head. Secretary.

CONTENTS

	PAGE
Record of Women's Institute Meetings and Membership.....	6
Annual Report of Board by Secretary.....	7
Chairman's Report, Lower Mainland District	18
Mrs. Lipsett's Report, Okanagan District	21
Mrs. Kilby's Report, Kootenay District.....	22
Mrs. Watt's Report, Vancouver Island District ..	25
Minutes of Meetings of Board.....	26
Recommendations of Board	36
Lecturers and Demonstrators.....	37
Institute Calendar	39
CONGRESS OF FARM WOMEN—	
Report of Official Representatives	40
Mrs. Lipsett's Report.....	46

RECORD OF WOMEN'S INSTITUTE MEETINGS, MEMBERSHIP, ETC., YEAR ENDING DECEMBER 31ST, 1912,
AS RECEIVED IN THE DEPARTMENT OF AGRICULTURE, VICTORIA.

INSTITUTE	Meetings	Attendance			Addressee	Members 1913	Cash Balance at Year 1913	Members 1911	Remarks	
		A. M.	P. M.	Evg.					Increase	Decrease
Agassiz	11		209		9	22	\$25.58	35		13
Burton City	9		135		1	36	23.18			
Boundary						59				
Cowichan			22		1	28	17.50		14	
*Colwood	14				5	43	2.60	29		
*Cranbrook	21				7	41	66.30	31		
Central Park	3		41	65	3	32	45.00	16		
Chilliwack	21		365	57	24	56	5.88	92		6
*Coquitlam	11				3	22	22.75	28		6
Comox	11		152		3	38	29.10	33	5	
Gordon Head	7	18	100		7	17	18.45	25		8
Hazelmere	9		154		3	57	33.35			
*Kaslo	16			40	16	90	304.95	41	49	
Lakehill	6		34		4	36	113.80	55		19
Langley	17		266	90	20	69	52.15	42	27	
Matsqui	14	29	139	50	15	30	3.77	29		
Mission	13				7	26	20.65	16	10	
Metchosin	8	25	55	145	6	45	17.55	46		1
Nakusp	11		230		3	41	24.97	33	8	
Nelson	10		242		6	107	38.20	114		7
Oyster Dist.			64			71	73.47			
Penticton	4				5	44	42.45	33	11	46
Royal Oak	24		279		7	83	22.30	129		
Surrey	9		237		12	24	84.15	15	9	
Summerland	6	51	137		3	67	101.66	40	27	
Salmon Arm	4		51		2	54	13.40	58		4
*Sooke	15	15			19	22	12.50	23		1
Salmon River	1	62			2	26	3.15	11	9	
Tynehead, V.	6					20				
	282				191	1336		974		

*No record of attendance sent in during the year.

ANNUAL REPORT OF ADVISORY BOARD WOMEN'S INSTITUTES, B. C.

August, 1911, to August, 1912

The first meeting of the Advisory Board was called by the Minister and held at the Parliament Buildings, August 21st and 22nd, 1911. Preliminary organization was effected and a programme of work laid down. The minutes, abstract of the proceedings of this meeting, with the recommendations made, was published in Women's Institutes Bulletin No. 43. The minutes of the meeting were submitted and approved. No further account of these proceedings is therefore submitted in this report. At this meeting a chairman, Mrs. Davies, was elected and a secretary, Mrs. Watt, and their work and that of the other members of the Board was assigned by the Superintendent.

Generally speaking the work of all members of the Board is to stimulate the interest in their respective localities in Women's Institute work in what ever way seems advisable. The chairman in addition is head of the Board and instructs the secretary in carrying out the wishes of the Board. The secretary is the executive officer of the Board, carries out the instructions of the chairman, does such special work as is referred to her by the Department and conducts the correspondence.

Immediately after the meeting, the minutes, as approved, were written out in full and sent to the Department and the members. The recommendations as made by the Board were all in the form of Resolutions and required re-drafting. These recommendations being the embodiment of our first work were published in our Bulletin.

ORGANIZATION OF THE BOARD.

The first important work undertaken by the Board was its organization under the authority of the Minister. There is no precedent to guide in the formation and organization of a Board, at once advisory to the Department, executive in its capacity, and with functions such as acquiring and disseminating information. The Act under which Women's Institutes are organized has little to say on the subject. Rules and Regulations of Women's Institutes authorize the appointment of such a Board with stated membership, but there is not much to go upon. So that the interior organization of the Board, the explicit defining of this relationship to the Institute, its status with the Department and so forth had at once to be considered. By-laws were drafted, approved and are now ready to be incorporated with the rules and regulations as revised and approved.

The secretary was instructed after the first recommendations were approved to bring these into effect as soon as possible. This was done

and the specific matters concerned were satisfactorily dealt with. Some of these are mentioned later.

On the instructions of the Minister, efforts were made to get in touch with similar organizations, and with Institutions having courses bearing on our work. Connection was established with the Ontario and New Brunswick branches, with Simmons College, with the Boston Domestic Science Schools, with Cornell University Department of Farmers' Wives organizations, with Home Economics Association of Manitoba, with the new Institute Branch in Alberta, with Macdonald College, with the Household Science Department of Toronto University, with the American School of Home Economics, with the Home Economics Association, and with other organizations.

As a result of these connections, a great deal of valuable information has been received in the guise of pamphlets especially. The members of the Board have thus become informed of the progress of Home Economics elsewhere and this information has been disseminated as far as possible, through the Institutes. Attention has also thus been directed to the Province among a class of people who are looking for homes for women workers.

THE INSTITUTES.

It was necessary also to get in touch with the Institutes and here also all caution had to be observed since there might be thought to be interference with individual Institutes. The contrary has been abundantly proven, since as soon as the idea of the Board and its usefulness permeated, full advantage was taken and the correspondence has greatly increased. It has taken the entire year to get completely in touch with Institutes. While some responded at once, others have only within the last month awakened to the fact that the Board needed information and the Institutes needed help: Now, however, every Institute is replying with fair promptness and is taking advantage of the Board being in a position to give information or solve certain difficulties.

Various methods have been tried in order that the members might keep in touch with the Institutes for the sake of the general progress of the work. A great many personal letters have been written [and it is the unanimous opinion of the members of the Board that there is nothing more effective than personal letters] and visits from the central worker to the branch Institutes. There has been little routine correspondence for each letter has presented a special need and has had a reply dealing with that need and adding words of counsel or encouragement. The best benefit of all that of personal visits by the members of the Board has been used to great advantage. The members are perhaps more reluctant to visit the Institutes than they should be owing to the fact that distances are great in this Province and travelling expensive. The instructions of the Superintendent are clear on the subject and it is likely that more visiting will be done another year as means of transportation becomes easier. It is undoubtedly true that the usefulness of some Institutes would have been over but for the encouragement of these visits.

Institutes are far apart and lack the stimulus of visits from one another and the isolated Institutes have suffered considerably, partly for this reason and partly because they were originally organized in an incomplete manner and since left to themselves.

Through the medium of the Secretary of the Board, papers by Women Institute members are now being exchanged among the Institutes and a friendly feeling is thus engendered. If the reports from the Secretaries could be made in triplicate so that the Secretary of the Board could have a copy, there would be still better connection with the Institutes. Still another means was the publication of our Women's Institute Bulletin. This publication with its department, "Notes From The Institutes" was a happy medium in closer connection. The Board has tried also during the year to keep in touch with the work of the Institutes by sending out articles to different publications dealing with their special work. These articles bring a direct message from the outer world and have often led to free discussion at the meetings. Pamphlets of a special interest published elsewhere have from time to time at the request of the Board been purchased by the Department and sent to the Institutes. This has been another feature in linking up our Institutes.

CORRESPONDENCE.

The main work of the Secretary of the Board has been the correspondence. Some idea of how this has increased may be judged by the fact that in April and May over 300 letters were dealt with. An average of 100 letters a month has been kept up. As has been explained little of this is routine correspondence, as every Institute presents different problems, and requires varying attention. Great care has had to be exercised with the letters sent out from the Board. The members are new to their position; to acquire the special official view point, to give sympathetic attention to the divers problems suggested, and yet not in any way to exceed their duties, but in every way to fulfill their responsibilities was not an easy task for women occupying for the first time, positions of this nature. That, however, we have succeeded in fitting in without trouble. It must be recognized as in part due to the care with which the correspondence was conducted. This part of the work has been most interesting, and the members feel that they have been able to be of some direct benefit.

LITERARY WORK.

The literary work of the Board has naturally devolved upon the Secretary, and has been an important and pleasing part of the work. Manuscript has been sent from time to time to the Cranbrook Prospector, The Victoria Times, The Vancouver Chronicle, and regularly since it was selected as our official journal, to the Canadian Home Journal. Attention is drawn to the fact that although matter has been sent regularly so far only the introductory notice has appeared and even that not headed as sent. The Secretary should be instructed to take the matter up with the journal. A number of other newspapers and magazines on the Pacific

Coast, and Agricultural Journals throughout Canada would be glad to have matter regarding our Institutes, and several requests have come to the Secretary lately for articles and accounts of our work.

When there are better office appliances available more can be done in this direction in the way of supplying matter and in distributing newspapers, etc., containing Women Institute items to the Institutes. The Chronicle of Vancouver has been sent each week to some of the Institutes, according as the articles therein seemed appropriate to their work. The preparation of circular letters to the Institutes regarding matters of general interest has been regarded as a means in the work. The subjects treated with have been such as should be brought to the attention of the Institutes and the fact that the letter is written directly to the Institute on any subject must arouse some attention. It is plain that in this manner a number of topics have been taken up at meetings, which perhaps otherwise would not have been considered.

The planning of study courses for the Institutes will have to be a matter for early consideration, but it is a heavy task and unless there is a general demand on the part of the Institutes for such assistance it is probable that for the present it may have to be left to individual efforts. One Institute has already a systematic course of study with the development of this work in Ontario of late years, it is likely we will soon have to fall in line.

The matter of the official journal for B.C. is, as stated, a problem requiring still further elucidation. Only papers and accounts of meetings of general interest are desired by the Canadian Home Journal, whereas our interests, in order that the work may spread, need an organ wherein space may be freely used. The Secretary hopes that early consideration be given this matter.

OFFICE EQUIPMENT.

The equipment of the Board for this work so far has not been sufficient. The fault lies largely with the members themselves, since at the outset they did not know what they should need, and since then have been backward in their requests. There are now in the hands of the Secretary, the twelve volumes of the Library of Household Economics, published by the School of that name in Chicago, and the following magazines are coming regularly: "The Canadian Home Journal," "Good House-keeping," and the "American Journal of Home Economics." Pamphlets also come from various colleges, experiment stations and departments. The Secretary also is permitted to purchase such pamphlets and magazines as seem desirable in the interest of the Institutes. Numbers of the Garden Magazine, The House Beautiful, Country Life, The Delineator, and other publications have been purchased and sent out from time to time to the Institutes. The excellent publications of the Seattle Board of Health, which are especially suitable for housewives and mothers, have been sent to every Institute. Pamphlets and Bulletins of different Colleges have been also distributed or handed about.

Attention is particularly directed here to the Bulletin lately issued

by the Good House-keeping Magazine Department, of investigating and testing household appliances containing results of investigation into recent domestic utensils. This is so exceptionally valuable a publication that it would seem as if at least the officers of every Institute should have a copy. It would be well also if this excellent magazine, certainly the best of its kind in the world, should be more widely known among our members. There should be a Canadian Good House-keeping Magazine.

The filing and arranging of papers has occupied far more time than it should had proper Filing Cabinets been at the disposal of the Secretary. A typewriter is also urgently needed. The necessary waste of time in making copies can thus be avoided and the official communications of the Board present a better appearance.

Suggestion was made that a room be set apart perhaps in the new Parliament Buildings for the use of the Women's Institute work. In such a room the Home Economics Library could be installed and Women's Institute exhibits be placed there. There could be desk room also for the members of the Board when in Victoria and later there could be a woman worker in charge, who would be ready to give information about this work to visitors.

COLLECTION INFORMATION.

When the Secretary assumed office there seemed to be little available statistical information concerning the Institutes. The Secretary of the Department stated that the Institutes did not send in reports or statistics, changes in officers, as regularly as should be done. The Secretary has now, however, collected, a matter of some time, full statistical and up-to-date information about the Institutes. She is now in a position to answer inquiries in this regard and indeed these are frequently received. The recommendation made by the Board of having the Institute report in triplicate should produce good results. [The reports also of the different members of the Board have this information.] The reports of the lecturers sent out by the Department could easily contain more valuable information than they do. We would respectfully ask that lecturers be urged to give as full report as possible, and that consideration be given to our recommendation that the lecturers be allowed some extra time to make up their reports. Too much importance cannot be placed on this branch of the work. It is absolutely necessary that the central workers are kept fully informed of all that concerned the work of the branch Institutes. It is very hard to awaken Institute Secretaries to their responsibility in this direction. Some of the Secretaries are fully alive not only to their own needs in this regard, but to those of the other Institutes, but most of them fail to realize that the work will never spread and will never be recognized by their Province as successful unless publicity is freely given to the work.

It has been part of the duties of the Secretary this year to collect and transmit items of interest to the Institutes. Considerable studying and reading has been done with this idea in view, and all the members of the Board feel much better equipped now than they did at the outset.

They have recognized that this work must be their chief concern and their reading and studying has been in this direction. It is not astonishing, therefore, that progress has been made and enthusiasm evoked. The improvements in household appliances of late years has been especially considered. The Secretary has visited a number of shops in the large cities on the coast, with a view to investigating the new labor saving appliances and has acquired many new ideas.

Many special lines of work have been undertaken at the direction of the Superintendent. The most important was the preparation of the Women's Institute Bulletin. Of this Bulletin, the members of the Board feel that they have a right to be proud. It has been received with universal interest by the Institutes and has been greatly in demand from the other Provinces. The information about the work in B. C., secured and published in this Bulletin, was a matter of surprise to the members in the Province. Prior to its publication there had been little interchange of ideas or communication between the Institutes.

This information was collected from many sources, from personal letters, from visits, from newspaper items, from reports, and often by hearsay, which had to be verified. Papers, sent in by members, were many of them of a high order and helpful; they came from members all over the Province. The articles contributed by the members of the Board were on topics of common interest to the Institutes. The arrangement and compiling of the Bulletin were approved by the Superintendent and his kind word of praise made the work easier. It is expected that the next Bulletin will be even better as the Board will have more help from the Institutes in its compiling. The outline has been drafted, presented to the chairman, and approved, but it will not be possible to get out a bulletin of any value until more material comes in. It is not likely much will be received until after the annual meeting in January. The publication of this report, however, if authorized, will fill the present need, as it includes the Institute calendar, book list, list of lecturers available, and other data of present interest.

SPECIAL WORK.

Under instruction from the Superintendent, the preparation of a book list was undertaken. A number of experts in special lines of home work were consulted and the list as completed and printed has their approval. Lists of magazines and pamphlets were also prepared for the Provincial Librarian, so that according to our request he could include in his Rural Travelling Library, books of special interest to homemakers in the country. The Secretary would like further to suggest that the matter of the McGill University lending Libraries and of the Toronto University lending Lantern Slides for use in Institutes be taken up.

The preparation of a Calendar or time table of Institutes containing the place, date, and time of regular meetings and also the list of officers, has been completed. This will, with your permission, be printed and will be valuable as a reference for all interested in Women's Institute work.

It is hoped that many more visitors and possible members will thus attend Institute meetings and that newcomers will be thus able to come quickly in contact with the Institutes.

A list has also been prepared to date of speakers and demonstrators available for Institute work in B. C. There are probably many equally good, but these ladies have applied or have been recommended to the Department for this work on instruction. The Board has investigated the qualifications of these ladies for Institute lecturing and demonstrating and is in a position to give any further information desired. It would seem as if the Institutes should feel some responsibility in the matter of providing extra speakers, that is, speakers other than those sent out from the Department in the spring and fall. The cost will not be great and the resultant benefit to the Institutes will be very noticeable. Other work assigned has been that of investigating the qualifications and merits of those desiring to be connected with this work and of the plans and suggestions regarding different lines of work sent in to the Department or to the Board. It is perhaps not generally recognized how many ideas and plans are brought to the attention of the Central Workers, on all lines of women's work in the country.

There are many plans for the settlement of woman farmers in this Province and for the spread of Institute work, which requires most careful consideration and which are often found to be such as we should like to see adopted, and perhaps the hardest part of the work is to report unfavorably upon plans, which may have great merit, but which are impracticable at the time when they were brought forward. The members of the Board would like to be well equipped for the discussion of agricultural problems relating to women and it is hoped that we will be given an opportunity for meeting those who come to this Province with plans for the settlement or work of women in the country. In this way we may receive new impressions and new points of view and thus be able to be of greater use in this work.

The planning of certain work among the Institutes has been referred to the Board, that of competition among Women's Institutes, whereby the endeavors of the members, both individual and in the Institute, may be recognized. We hope the plan we are submitting will meet with your approval.

[We are also submitting at your request a plan for Department assistance to the Women's Institute exhibition work, which we hope will be suitable.]

An important piece of work was that of the following up of the decision to select motto, badge and colors for the B.C. Institutes. After considerable shifting of the responsibility back and forward between the Department and the Board, the Secretary was able finally to announce to the Department the decision to recommend the motto, "For Home and Country," as used by Ontario, and for badge the pin of Ontario, but in our own colors and with the initials of our own Province. The choice of colors made was green, white, and gold, and has met with great

favor from the Institutes. Reasons and significance for this choice are given at some length in our bulletin. A request came from the Cranbrook W. I. for an official ribbon, but it was not felt that this expense could be at present recommended.

A statement was made in the newspapers that the Dominion Department of Agriculture was to give an annual grant to the Province to aid in the development of agriculture. The Secretary at once communicated with the members of the Board to see if they would make recommendation that part of this sum be applied to the encouragement of women in agriculture. The members agreed that if a proportion of this sum could be secured it would stimulate the interest of women in agriculture. A request that this aspect of the matter be considered was transmitted through the Superintendent to you, Sir, and to the Hon. Minister of Agriculture for the Dominion, and we hope that definite action will be taken. On the instruction of the Superintendent a plan has been prepared for the use of this fund should such be granted.

RULES AND REGULATIONS.

The matter of the rules and regulations regarding Women's Institutes was taken up under direction of the Superintendent. The officers of the Institutes were consulted as to what changes or additions seemed necessary in view of the changing conditions of this work. The members of the Board also made a careful study of the rules. A meeting was held to specially consider them and certain recommendations were made. These recommendations were for the most part approved by the Superintendent and the Secretary was instructed to draw up the rules again, embodying these changes, but the work is still to be dealt with.

ITINERARIES.

After the first meetings of the Board its recommendations regarding the fall itinerary were carried out. The Institutes were favorably approached in the matter of the Prize Menus and the suggestions being favorably regarded, the matter was set in train and the details of the competition worked out in conjunction with Miss Livingstone, who had agreed to undertake the fall lectures and demonstrations. The Secretary kept in touch with Miss Livingstone until her tour was over, the menus sent in and judged, the prize winners announced and all results tabulated. By way also of further emphasizing her work, articles and clippings on "cookery" were sent to each Institute within a short time of the close of her tour. The Secretary also went with Miss Livingstone to Colwood and to Metchosin to her first meetings and was able to see that all had begun satisfactorily. A good deal of correspondence was involved in the arranging and carrying out of this tour and its special features, but in view of the splendid results and the gratification of the Institutes, the time need not be grudged.

The spring itinerary was arranged after the Conference by the chairman and secretary of the Board, of which mention will be made later. It was decided to send a lecturer who should take up agriculture and

horticulture as occupations for women. Many of the Institutes were desiring information along these lines and it was felt by the Members of the Board that such a series of lectures would be particularly helpful in the spring of the year.

The services of Mrs. Davies were secured, who lectured on Market Gardening, Floriculture, Poultry and Dairying For Profit, with special references of the undertaking of the various branches of its work by women. In connection with her tour it was planned to have Flower Shows held by such Institutes as were willing to do so. The tour of Mrs. Davies was a great success and was found especially helpful to newcomers on small acreage desiring to make a living therefrom. The greatest interest was displayed in her lectures and a general stimulation of horticulture ensued. Mrs. Davies' report on her trip was most interesting and showed her to have been a careful observer. More of such reports would enable us to have more satisfactory knowledge of the work of the Institutes.

The flower shows held at the time of her visits to the Institutes and some later in the year deserve a special mention. At the outset a circular letter was sent to the Institutes, asking for their opinion of this matter. Later explanatory letters were sent and favorable responses began to come in. The Secretary was able to be of assistance to the Institutes with the exhibits. Prize lists were sent from one Institute to another. Letters, articles, and pamphlets of gardens and shows were sent out to the Institutes and help gladly given. The intention was, of course, that all arrangements should be left to the Institutes themselves, but as the work was new there were many enquiries made and we hope satisfactorily replied to. The Superintendent, considering the idea a worthy one, authorized the presentation of prizes from the Department at each Flower Show held. The Secretary of the Board was directed to secure these prizes. A number of beautiful books on gardening were secured from the local booksellers. An inscription was put in each of the prizes sent out in the name of the Department. The Superintendent also kindly allowed members of the Board to attend these Flower Shows and present the prizes. The shows were a great success and the Institutes have decided to make this an annual event of Institute work in B.C.

In anticipation of these shows being held next year, many of the Institutes are co-operating and ordering large quantities of bulbs and seeds. The members will thus have the benefit of cheaper prices. It is hoped that an appreciable difference will be made in the appearance of country homes by this stimulus to horticulture. Many more perennials as well as bulbs are being provided and it is hoped that work will be stimulated still further next year.

EXHIBITION WORK OF INSTITUTES.

In connection with the Flower Shows many of the Institutes held an exhibit of women's work and many of the prize lists were sent to the Board. This seems to be a part of Women's Institute work of a special interest and value and it is hoped that before next year some definite decision may be arrived at as to how these exhibits can best be conducted and aided,

DOMINION WORK.

On instruction the Secretary has been trying to work up the idea of co-operation between the Provinces of Canada. Communication has been established with Ontario. We paid a tribute to their pioneer work by adopting their badge and motto, and frequent interchange of letters and pamphlets. We have approached all the Provinces of the Dominion in this regard. New Brunswick responded in a gratifying manner by agreeing also to take the motto and badge of Ontario. Nova Scotia will do the same when fully organized. Alberta, which is also completing organization, intends to do so and Manitoba and Saskatchewan have the matter under consideration. There will be much more to report concerning Dominion co-operation later as several matters under co-operation are now being undertaken, notably, official publications, Central Council, Official Organ, and so forth.

WOMEN IN AGRICULTURE.

The members of the Board would like to see the matter of women in agricultural pursuits brought forward. The Secretary has interviewed a number of women who have come here chiefly from the Old Country with a view to settling as women farmers in B. C. Many women, English women especially, are particularly fond of these outdoor pursuits, and little encouragement is given by the educational system or the Departments of Agriculture to would-be women farmers. Women cannot work under exactly the same conditions and exactly the same ways as men, and while so much money has been spent on the improvement of agriculture, it seems only fair that women should have a fair proportion. Horticultural and agricultural occupations should be as much a part of the school training of girls in the country as any other technical instruction, except that of Home Economics, which should come first. The Secretary has done special work in this regard as convener of the committee on this matter and is of the opinion that the time has arrived for this matter to be taken up in earnest. The Board is asking that women be placed on committees on agriculture and on other commissions which deal in part with women's work.

FARM CONGRESS.

Special mention should be made of the bringing of our Institute into touch with the Congress of Farm Women to be held at Lethbridge in October. This great gathering will be of notable interest, and it is hoped that the information which the Secretary has had transmitted to the Institutes regarding this Congress will lead to a large delegation being present. The Superintendent has kindly promised the support of the Department to our efforts to take some part in this Congress.

REPORTS FROM THE MEMBERS.

Each member of the Board has submitted a report concerning the Institutes in the district in which she resides, and these reports are full of interest. The Chairman, Mrs. Davies, owing to ill health, was absent from the Province for several months. She, however, as her health permitted, visited various Institutes and education institutions whose line

of work is similar to ours, so that she has been able to bring back many valuable ideas. Mrs. Lipsett was also away for some months at another time of the year, and saw many phases of women's work. The reports of the members are appended to this report.

MEETINGS.

The second meeting of the Advisory Board was held on August the 5th in the Parliament Buildings, the Chairman, Mrs. Davies, not being able to attend. While her absence was keenly felt, a great deal of work was got through with. A new feature of the meetings was a visit of women workers, mostly new arrivals in the Province, who wished to take over plans of work. Many of the letters were dealt with and their carrying out will form part of the work of the Board for the next few months. The minutes of the meetings were submitted and approved. The minutes of the meetings as approved were sent to the Superintendent, and his consent formally obtained to the carrying out of the recommendations approved of. It was asked that these minutes be published in the annual report.

In conclusion, I would draw your attention to the spread of the work since the Advisory Board was appointed. For some three years, the membership of a number of Institutes had remained almost stationary up to the time of the appointment of the Board. By the time this report is in your hands there will have been an increase in membership and number of Institutes which is most gratifying. There have been 7 new Institutes formed within the year and three more in process of formation. The membership has increased from 800 to 1100. At this rate of progress there will probably be soon as many Women's Institutes as Farmers' Institutes. We feel that we have been able, under your authority and with your support, to do some good work and we hope that our Institute work will keep pace with the advancement of the Province. We may, perhaps, be permitted to say that already the name of your Superintendent of Institutes is well known throughout Canada as that of an Institute worker thoroughly in sympathy with the aims and objects of Women's Institute work. The members of the Board are fully aware that their best efforts would have amounted to but little but for the support and sympathy of the Superintendent.

I have, etc.,

M. R. WATT,

Secretary, Advisory Board of Women's Institutes, B. C.

LOWER MAINLAND DISTRICT.

Report of the Chairman of the Advisory Board.

W. E. Scott, Esq.,

Superintendent of Institutes, B.C.

Sir,—I beg to present my annual report of work done among the Women's Institutes of the Lower Mainland, B.C.

I have, etc.,

M. S. DAVIES,

Chairman, Advisory Board, Women's Institutes, B.C.

September, 1912.

My first visit was to the Langley Institute. I was kindly met at the Tram Station and driven to Fort Langley to the home of Mrs. Coulter, the President of the Institute, who entertained me.

About 2.30 we went over to the Agricultural Hall, where the members were assembling. A pleasant hour and a half was spent—14 ladies were present.

A little business was transacted. Then the President called upon me and I spoke for a short time on Institute work. It was a most informal session, questions being asked as to their work and aims and they in turn questioned me. I may say that this was the order at each Institute I visited and I think resulted in benefit on both sides.

The Langley Institute have conducted a Flower Show for the two summers they have been in existence and have devoted all their funds towards making this a success. Last summer the expenses amounted to \$46.00, leaving them with very little in the Treasury. They have taken up sewing in some of their sessions, having a dressmaker come in and illustrate cutting.

It was a Langley member who suggested having a W. I. pin. The majority of the members live so far away that the attendance is never large.

From Langley I went down to Central Park. They have a smaller membership, only 16. Of these 11 were present. They are not in as flourishing a condition as some others. The proximity to Vancouver accounts for this, they said.

In 1910 they gave sewing prizes for children at the Exhibition. In 1911 the prizes amounted to \$4.00. They had \$8.00 in Treasury, but did not feel like taking up any special work. The ladies are capable and will in time prove themselves, I feel sure. They meet in the Agricultural Hall, through the courtesy of the Agricultural Society.

Agassiz has a good Institute with able members. They meet in the Town Hall and pay 75c a meeting rental. At the Fall Fair, they gave \$13.65 in prizes to children for flowers and vegetables. They have \$34.00 in the Treasury. The Secretary sends notice of meeting to each member with topic to be discussed and asks them to come prepared to ask the leader of discussion two questions, quite a novel idea.

They have a membership of 38. Of these 15 were present.

At each one I urged possible the appointment of a Programme Committee, the social side meetings, the using of the Travelling Libraries when they come, magazine clubs. They all have Institute picnics in the summer.

Matsqui was my next call. I was most hospitably entertained by Mrs. Cruickshank. This Institute is alive, finds work to do in the community and does it well. Their membership is 24 besides 14 honorary members. There were 22 ladies at the meeting, but the usual attendance is only 12. One pleasing feature was the number of young ladies, members, and taking an interest in all the work and plans. A year ago they gave monthly social evenings all fall and winter, using the funds thus raised to finish payments on a piano for the Town Hall, where these were held. They had \$120.00 in the Treasury and voted at this meeting to use it to paint the Town Hall and raise more to properly finish the Hall. The members answer the roll call with helpful verses.

Cloverdale was the next Institute visited. Those interested find it very hard to keep it alive. There are 14 members but the attendance is only 3 or 4. Their funds are \$7.20; they spent \$4.50 in the spring planting trees around the recreation grounds. Mrs. J. Croft, the Secretary, kindly entertained me.

Chilliwack Institute came next. This is the only Institute I visited having a Programme Committee, who arrange all meetings, provide printed programmes, demonstrations, etc., and serve refreshments at the meetings. The Programme Committee arranges a social afternoon once a month at the house of one of the members, and have an informal social time. Each brings their needlework, new members are introduced, refreshments served and a 10c collection taken. A rest room is maintained at a cost of about \$215.00 a year. The merchants each give from 25c to 50c a month towards the maintenance and the Municipal Council \$3.00 a month.

My next visit was to Mission City Institute. They had 13 members and two ladies joined at the close of our session. Their meeting place, the old school-house, is not very comfortable and I suggested if they could meet in a private home for the winter it would be cosier. Six ladies were present at the meeting, the usual attendance I was told. They had \$4.00 in the Treasury, no Government grant being received this year. Matsqui, lying just across the river, I suggested the return of visits from one Institute to another; this often is a great help to both Institutes. Mission Institute takes up no special work. I was entertained by the Secretary, Mrs. Abercrombie.

April 2nd:—I visited Cloverdale Institute by invitation. There was a splendid attendance of 18 ladies. The membership is more encouraging this year. Mrs. Croft gave an interesting paper on "Sleep" and I spoke for a short time on "Dust and Its Dangers." There seems to be a spirit of enthusiasm about this Institute now. On April 4th I met the Secretary of the Board of Victoria and we had a busy day, read material for Bulletin, discussed plans for spring itinerary, Institute pins, lectures, etc.

The recommendations passed upon were presented to the Supt. of Institutes, Mr. Scott, and thoroughly discussed. These have been sent to the members of the Board.

On reaching Vancouver Friday evening, April 5th, I interviewed Mrs. S. K. Davies, concerning the spring lectures and explained the plans discussed by the Supt. of Institutes with the President and Secretary of the Board, regarding the flower shows and her part in them.

April 18th:—Upon invitation sent by Mrs. Hardy, of Hazelmere, I went there to assist in the organization of an Institute. Leaving the B.C.E.R. at Clover Valley, I was met by Mr. Hardy and by Mrs. Currie, Secretary of Cloverdale Institute. After a pleasant drive of four miles, we reached our destination. A splendid meeting was held during the afternoon at the Union Church, 16 ladies being present.

Mrs. Tucker was voted to the chair and Mrs. G. Hardy appointed Secretary. After a few remarks from the Chairman, I was introduced and spoke on Women's Institutes, the need of them in rural communities, benefits to members, etc.

The Hazelmere W. I. has an energetic and resourceful staff of officers and bids fair to rank soon among the largest Institutes. Though less than six months in existence, it has a membership of 60.

The roll-call at the August meeting was answered by "The Name of Our Birthplace."

There were responses from every Province of Canada, except P. E. I., from 13 different States of the Union, from England, Ireland, Scotland, Denmark, France, Germany, Switzerland, Spain, and one from Hall's Prairie, B.C., where the Institute is situated.

The President says, "I was surprised by the cosmopolitan membership and a more agreeable society of ladies I have not met." There were two interesting papers read at the October meeting, "The Benefit of Music in the Home," and "The Thanksgiving Dinner." These with music and a friendly cup of tea made a splendid meeting.

There were between 35 and 40 ladies present.

Resolutions were passed to form a Hazelmere W. I. and also to canvass till the necessary 25 names were procured. At the next meeting over 25 ladies signed the membership list and requisition was made for recognition from the Department. There is now a membership of 60. The nine Institutes in my district were written to at the beginning of the year 1912, asking for copies of their annual reports, also for reports from time to time. Six responded within a month, but have received no further reports. I felt that only in this way could I keep in touch with them and be informed of their progress and work.

Langley, Matsqui and Chilliwack have given me their monthly programmes for 1912, and they show a careful study of helpful and timely topics. In each of these Institutes, the officers declare that there is a decided increase of interest among the members both in regard to the

regular meetings by reason of these programmes and also towards each phase of Institute work.

From August 1st, 1911, to August 1st, 1912, I wrote Institute letters, not counting the correspondence with the Secretary of the Board. I regret that, owing to ill health, I was obliged to lay aside active work on the 1st of May, and go away for a rest. While away I visited an Institute at Lakefield, Ont., and one at Dunham, Province of Quebec, besides a Home Economics meeting at the St. Johnsbury, Vermont, Woman's Club. They were pleased to hear of Women's Institute work in B.C., and sent greetings back to our Sister Societies here.

I also visited the Macdonald College at Ste. Anne, near Montreal, and spent a week visiting the different classes of Domestic Science. I hope that our Board may be instrumental in having such a splendid Institution started in our own fair Province where our girls may gain practical, useful and often sorely needed training to fit them for the best homemakers.

Respectfully submitted,

MARY S. DAVIES.

OKANAGAN DISTRICT.

Mrs. Lipsett's Report.

Summerland, B.C., August 19th, 1912.

Wm. E. Scott, Esq.,

Superintendent of Institutes, Victoria, B.C.

Sir,—I beg to present my annual report of work done among Women's Institutes of the Okanagan District for 1911 and 1912.

There are three Institutes in this district, at Salmon Arm, Summerland and Penticton. I met with the ladies of the Salmon Arm Institute in the latter part of August, 1911, and found them very enthusiastic in their work.

The Secretary reports a membership of 48. They had been hampered very much by a lack of matter on the subjects taken up. This will be overcome by the suggested help sent out by the Department. Their year's work has given the ladies a great deal of useful information as well as pleasant recreation, and all consider the Institute a boon both to the family and the community.

The Farmers' and Women's Institutes work together in getting up socials and entertainments. The women always take the first part of the entertainment, and thus their work is brought prominently before the public. They have found this method a success both socially and financially.

The Institute gave \$50.00 towards the building of an Agricultural Hall. When completed the ladies will have a room for meetings, demonstrations, etc. Several papers had been read at the meetings. Two "Economy in the Home" and "Hospitality," with a few original recipes, I forwarded to the Secretary of the Advisory Board.

SUMMERLAND.

In August, 1912, the Secretary reports a membership of 70; nine meetings, all well attended. Papers had been read on "Bees," "Chickens," "Roses and Dahlias," "Making of Lawns," and "First Aid to the Injured." They have had demonstrations on shirtwaist making, boning chicken, biscuits, strawberry shortcake, etc.

Special prizes had been given for women's work at the fall fair. Sociability is encouraged in every way and real friendship is awakened between far distant neighbors. Miss Livingstone's visit in November was very much appreciated. The ladies turned out in force, and her talk on balanced rations for children, invalids and adults set all thinking. Her suggestion that members write out on seven slips of paper seven everyday dinners was responded to later by three ladies. Between 50 and 60 ladies attended each session, the well-filled notebooks showing their determination to profit by what they heard.

On June 17th, Mrs. Davies, of Vancouver, spoke on Market Gardening and Floriculture for Profits. Many questions were asked and answered on the above subjects and on Poultry Raising From a Commercial Standpoint. Many useful lessons were received, which the ladies considered would be of practical benefit to them in their future work.

An attempt was made to organize an Institute at Naramata. The ladies there had their club and concluded they would prefer to join the Summerland Institute for a time. Seventeen ladies have since joined.

PENTICTON.

This Institute reports 37 members and eight meetings. Their sessions are always interesting and fairly well attended. Their fees and the money received from the Government was used for Institute purposes. They had a tea room at the Fall Fair and also had a Tag Day. The money received from these they were raising for the furnishing of a hospital, which will be built soon.

The Institutes are all anxious to know how to make their meetings more interesting and how to get the different women to work and the girls interested. We shall try to bring real results from this questioning in the next year. I have written the Institutes several times. I shall try to get more in touch with them next year so as to bring the interests of the Institutes nearer together.

R. L. LIPSETT.

KOOTENAY DISTRICT.

Mrs. Kilby's Report.

Superintendent of Institutes,
Victoria, B.C.

Sir,—I beg to present my annual report of work done among the Women's Institutes of the Kootenay District.

The four Institutes in the Kootenay District are in a flourishing condition and each doing good work. On the 27th of October, 1911, I

visited the Kaslo Institute, where owing to church tea taking place that afternoon at one of the member's homes, the attendance was not as large as it would otherwise have been. I found the ladies present very enthusiastic and justly proud over the success of the fall fair, which, by the courtesy and assistance from the Department, they were enabled to carry on. From the proceeds of this fair, the Kaslo Institute was enriched by \$424.00, a very creditable showing for an Institute whose members number only 47.

At this meeting a resolution was passed to petition the B.C. Government to amend the Statutes governing the Dental laws, so as to enable a dentist to come into the Province and practice without having to wait six months before doing so. This has since been brought to the attention of the Department through the Advisory Board and though we found that, owing to it being a matter of legislation asked for, little could be done. We hope, however, to get results for Kaslo in other ways. I may say that Nakusp is in the same position, and a dentist locating at either place would be royally welcomed.

September, 1912.—I had a letter from their Secretary a few days ago and she reports a membership of 81.

On November 7th I visited the Cranbrook Women's Institute on their regular meeting day, and found from a membership of 33 an attendance of 30, which speaks well for the Institute. After the business of the meeting one of the members, Mrs. Murgatroyd, demonstrated the making and icing of a mocha cake, which was afterwards served with tea, and the balance of the meeting was spent socially. This Institute holds an annual picnic each summer, to which every one is invited. The matter of having an evening a month for the social side of the Institute was decided upon. Papers have been read and various recipes and demonstrations have been given at the meetings. Miss Livingstone's lectures and demonstrations were greatly enjoyed by all the Institutes in this district, and great satisfaction was expressed by the Cranbrook Women's Institute at the granting of two days instead of one for these demonstrations, as it was from a suggestion by this Institute brought up at the Advisory Board meeting last summer that the change was made.

On December 13th I arrived at Nakusp, where the President, Secretary and one of the members met me and escorted me to the home of Mrs. R. A. Quance, (the present President), where I was entertained during my stay. The meeting was held during the afternoon at the home of Mrs. Abbie. The Institute meetings here are held monthly at the homes of the different members. Papers are written and read by members, followed by discussions, and there are demonstrations too, suitable to the time of the year. The Nakusp Women's Institute is the only one in the Kootenay District so far that has the yearly printed programmes. This Institute started two years ago with a membership of nine, which has since increased to 36 members, the average attendance being 20. A prize was given at the fall fair for the best hand-made apron made by a member, and a rest room was also fitted up by the Institute for the

ladies during the fair. The good work of having the cemetery fenced and looked after has also been undertaken.

At the Nelson Institute, interesting meetings have been held, at which various demonstrations in cooking have been given, such as boning a turkey, soup-making, the making of different kinds of cake, icing a cake, quick desserts, the moulding of butter in fancy shapes for the table, marmalade making, candy making, paper bag cookery, by the local Domestic Science Teacher. Ten papers have been read, sewing and millinery lessons also being given. The meetings are usually opened by musical selections and solos given by the best local talent. The meetings are always well attended, and altogether, I can safely say that the Institute has been a help to the women of Nelson in many ways. Last fall, at the fair, a rest-room was fitted up, which proved a boon to many a weary mother, as a nurse was engaged for the two days to care for the babies, and another woman took charge of the parcels, which were checked for the small sum of ten cents each. To help defray expenses, a cake donated by a member, was each day raffled. The Nelson Institute meets in its hall or permanent rest-room, where all last winter it ran a Women's Exchange of fancy work and home cooking, which was open six days a week with a caretaker in charge. This Institute started two years ago with a membership of 23, which has since increased to 107 members.

Since my appointment on the Board I have had considerable correspondence to attend to, all of which I have tried to do promptly and to the best of my ability. From this district I have also collected and forwarded to the Secretary of the Board for publication: Two papers from the Nakusp Institute, two from Kaslo, one paper and a "write-up" from Cranbrook, and three papers and one "write-up" from Nelson.

At a meeting of the Nelson W. I. last month a paper was read on "How to Get Rid of Flies," and afterwards thoroughly discussed. The members hope to start a movement which should help materially towards ridding Nelson of this pest. A committee was appointed at this meeting to wait upon the managers of the Picture Shows here and request that films be obtained to illustrate the amount of harm done by the insignificant fly.

The Flower Show at Nelson did not materialize owing to the scarcity of flowers at the time of Mrs. Davies' visit. The city had also to postpone their show for the same reason. At the Fair this fall the Institute is giving a prize for the best collection of pansies by members, as well as prizes for the best hand-made kitchen apron. A standing W. I. exhibit of canned soups, vegetables, meats, berries, fruits of various kinds, etc., is also under consideration by the Nelson members, of which I hope to report upon more fully at a later date.

At the present time (August 5th, 1912) I am pleased to report that the Nakusp Institute have almost enough to pay for the four lots and fence purchased for the cemetery, the price of lots being \$46.95, fence, \$85.00, making a total of \$231.95.

This money was raised by the giving of teas and two ice cream socials

at one of which \$58.00 was realized. The President, Mrs. R. A. Quance, reports very successful meetings, which very often commence at 2 p.m., and they find very hard to conclude at six. The Nakusp Flower Show was also a great success and Mrs. Davies' lectures were much appreciated. The Department prize was awarded for the best collection of wild flowers gathered and arranged by children, the second prize being \$1.00.

For the best collection of house plants, a prize of \$3.00 was given; second prize, \$1.00. For the best bouquet of cut flowers, \$1.50 was given.

A demonstration on the making of ice cream was given at this meeting, after which the cream was sold and enough made to pay for the prizes.

I have, etc.,

S. KILBY.

VANCOUVER ISLAND DISTRICT.

Mrs. Watt's Report.

The Superintendent of Institutes,
Victoria, B.C.

Sir,—I beg to submit a brief report of my special work among the Vancouver Island Institutes. On Vancouver Island, two new Institutes have been formed during the year—at Duncan and at Ladysmith. Both started under favorable conditions. I visited Ladysmith on request of Mrs. John Stewart, and spoke at two meetings. A few days later the Institute was formed with a membership of 37, and since, I believe, has increased its membership.

The Duncan Institute was formed by Miss A. Hadwen. Miss Hadwen is to be congratulated on forming an Institute in a district which has previously been unresponsive. This Institute will, probably, however, do a very good work, and there are certainly great prospects in Cowichan District. There are many talented women in the locality and a spirit of progress, so that we felt a good move has been made. Requests have come in from Parksville, Nanaimo and Alberni for information regarding Institute work, and it is possible Institutes may be formed in these places. That is as far as Institutes can spread on the Island at present.

The Gordon Head Institute I have not been able to visit this year. On several occasions I planned to do so. The Secretary, however, answers all letters promptly. The Institute is in good condition. I hope to visit it next year.

I have attended regular meetings and Flower Shows at Metchosin, Royal Oak and Colwood. In all of these places there are flourishing Institutes well conducted, and under good leadership are making good progress in the work. Lake Hill is another Institute of which Vancouver Island may well be proud. Sooke keeps up its good record. Comox, considering its more isolated position, is doing good work.

I have, etc.,

M. R. WATT,

Secretary, Advisory Board Women's Institutes, B.C.

MINUTES OF MEETINGS, ADVISORY BOARD OF WOMEN'S INSTITUTES.

Department of Agriculture, B.C.

Parliament Buildings, Victoria, B.C., August 5th to 7th.

Present the Hon. the Minister of Agriculture, the Superintendent of Institutes, Mrs. Lipsett, Mrs. Kilby, Mrs. Watt (Secretary).

The Minister was introduced by Mr. Scott, who asked the Board to take up at once with the Minister matters requiring his special attention, as he would be unable to be present in the afternoon.

Mrs. Watt then presented on behalf of the Board a number of reports and other matters. A list of suggested speakers for Institute meetings was shown Mr. Ellison. He advised caution in the matter, especially in dealing with local speakers, to exercise care in selection so that speakers should not talk before Institutes in their own neighborhood unless asked.

A list of matters which the Board was to take up at this session was then given the Minister and he took up several of these and discussed them fully. The first matter dealt with was the Federal Grant, a sum of money given by the Dominion to the Provinces to assist agriculture. The Board had earlier in the year recommended that a part of this grant be asked for and the matter had been taken up both with the Minister of Agriculture for the Dominion and the Minister of Agriculture for B.C. The Superintendent had expressed his approval and the Board now wished to see what could be done. The Minister expressed his sympathy with the idea and Mr. Scott spoke in approval, pointing out that there was no reason why a proportion of this grant should not be devoted to the encouragement of women in agriculture. The Minister wished to know what the Board would suggest how to use this part if it were given. Mrs. Watt said that the idea which the Board had in mind was to establish some form of Farm Settlement, where women farmers could learn local conditions before starting on farms of their own, and where they could stay while they were looking out for land. It was felt that women farmers would be a great asset to the Province and that it would be a good thing to thus protect them on arrival from loss of money in different ways.

Mr. Scott stated that various enterprises which had the idea of such settlement had been brought to his attention during the past year and the co-operation of the Government seemed to be all that was lacking in some instances. He cited the Colonial Intelligence League and its proposals. The matter was fully discussed with the Minister and this use of part of the funds was endorsed by all. The Minister then asked the Board to go into the question carefully and make a report to him.

The next matter taken up was the holding of the flower shows by the Institutes during the present year. The Minister was pleased that the idea as promulgated by the Board had been so well taken up by the Institutes, and inquired as to other features of the shows. Mrs. Lipsett explained that in Summerland the occasion was made a display of women's work of various sorts as well as of flowers, and she understood

that other Institutes had done likewise. She thought that the encouragement of this sort of fair was greatly in the interests of the Institutes. The Minister expressed his entire concurrence with these views and explained the manner in which he thought such fairs should be conducted. His suggestions were listened to with deep interest by the Board. He considered that a way might be found whereby articles exhibited might be sold for the benefit of the Institutes or of the owners. The latter course might open ways of earning money for women in the country. It was surprising often what splendid displays were made.

Mr. Scott spoke of what assistance might be given in the event of such shows being an annual event. He said that the Department prize of a book at each flower show this year had been much appreciated and Mrs. Watt added that the giving of this prize had stimulated interest more than anything else and that the entire cost had been slight, especially in view of the results.

Mr. Scott thought that a per capita grant might be given of say, 25c, in addition to such book prizes as might be given to special lines of endeavor, horticultural or otherwise. The members agreed that this assistance would likely stimulate almost all the Institutes to hold such fairs.

Mrs. Watt reported that 19 out of the 24 Institutes had held Flower Shows, although many had only a few weeks' time to prepare. It was also her pleasant duty to announce that, according to late returns, there are now 1100 members in the Province as against 800 last year. All present expressed pleasure at this evidence of progress.

The next matter was that of the Farm Congress at Lethbridge in October. The members of the Board expressed the opinion that the Secretary of the Board should be sent to represent the Province at this International Congress of Farm Women. The Secretary stated that if a member of the Board were sent it should be the Chairman, but as Mrs. Davies' return was uncertain and it was doubtful whether she would wish to leave home again so soon, the other members thought it best to make certain of having the Secretary go. The Minister thought the point well taken as to the official representation, but as he had already agreed to pay the expenses of Miss Ravenhill, who was going there to speak on Domestic Science, he had not further considered the matter, but would do so now with Mr. Scott and let the Board know his decision.

The new Bulletin of the Advisory Board was then considered. Mr. Scott stated that it was a fine piece of work and that he was more than pleased with it. He counted on its greatly assisting the work of the Institutes. The Minister inquired as to the number of copies ordered. Mr. Scott stated that 3000 had been ordered, an unusually large number, but he felt that it could be sent out with resulting benefits to the Province. There was likely to be a great demand for it. The Minister also praised the work, but as it had just been put in his hands, he would consider it later. It seemed to him to be just what the Institutes needed.

Mrs. Watt said that the hardest part of the work had been the

securing of information about what the Institutes were doing. Many of the Secretaries had very little information to give and there was very little of value on record. She was glad that the Bulletin met with such approval.

The Minister then addressed the Board. He made a most encouraging speech, expressing his pleasure at the work, which had been accomplished, and the manner in which it had been done. He gave practical and instructive counsel and promised his personal attention to all matters the Board laid before him. He stated that in view of the excellent results obtained by the Board that he was prepared to go further and spend more money this year, and hoped to get still better results. The appropriation was double this year that of last for the work of Women's Institutes and there would always be the necessary money so long as the results were being had. He hoped that the work would continue and that wherever there was need that the Board would try their utmost to help out. He agreed that only the best lecturers should be sent out and that the idea of Institute competitions, as outlined by the Board on Mr. Scott's instruction, was good and he would consider further suggestions on the subject. He assured the Board of his deep sympathy with the objects and aims of the Institutes and promised the fullest departmental co-operation in any work recommended.

Here the Minister further stated that he considered that the longer sessions of demonstrators as recommended by the Board was beneficial. He favored courses of study and lectures. Too often lecturers came and went and their words were soon forgotten. He would like to hear of some plan whereby the best results could be obtained from the lecturers' visits. He was afraid that distances were too great in this Province for the dairy vans, travelling schools, model kitchens, and so forth, which were sent about in European countries, but he would like the Board to keep that idea in view of getting the best results from the demonstrators and to work out plans by which more extensive instruction could be given.

The Minister then wished the Board success and said that if any other matters came up requiring discussion with himself that he would be available.

Mrs. Lipsett thanked the Minister for his most encouraging address and hoped that the work of the Board would continue to meet with his approval and that of Mr. Scott, who was also doing so much to help.

Afternoon Session, August 5th.

Mrs. Watt in the chair.

Most of the afternoon was taken up with interviews. Mr. Scott introduced Miss Gerrard, who had brought a letter from Hon. Martin Burrell. Miss Gerrard explained her work in England as Dairy Instructor in a travelling dairy school. The Dairy Van, she explained, is taken from place to place with an instructor, often remaining only one day in each place, but giving in that time expert instruction in butter-making, separation, milk-testing, use of thermometer and so forth. Miss Gerrard gave most interesting descriptions of this work in England.

Mrs. Hutchinson, the new President of the Royal Oak Woman's Institute, laid before the Board a suggested series of Institute competitions. The idea was to have a competition each month and to have silver spoons with an official insignia on them as prizes, and to stimulate members to work for a collection of these spoons. She felt that women might be induced to take up lines of work in which they would gain proficiency and perhaps later use in earning money. The members of the Board expressed sympathy with the idea. Mrs. Kilby thought it might be tried to advantage in many institutes. Mrs. Lipsett said there was nothing more needed than remunerative work for women in the country. It was later moved that after Mrs. Hutchinson had worked out the idea in her own Institute, she be asked to report on its success. The Board could then take action and recommend, perhaps, that Mrs. Hutchinson promulgate the idea before the other Institutes. Mrs. Hutchinson was thanked for her suggestions.

Miss Wells, Sewing Instructor, was interviewed by members, and samples of her work examined. Mr. Scott stated that sewing demonstrations were desired by the Institutes and he would be glad if the Board could find some one who could give expert instruction along these lines. Mrs. Lipsett pointed out that it was not so much sewing instructions that was desired as dressmaking demonstrations, and for that purpose only an expert dressmaker up in the latest methods would be of any value. The work of Miss Wells was excellent, but it was felt that the Board could recommend her only as an instructor in plain sewing, millinery, children's clothes, underwear, and that at the present a dressmaker was most required.

The annual report of the Board was then taken up and the outline as laid down by the Secretary was approved. Mr. Scott concurred and said he would authorize the printing of it.

It was then moved,—

Resolved that the Annual Report of the Board be published and contain—

Sections of Act relating to Board.

Bylaws of Board.

Personnel as at present constituted.

Minutes of Meetings and of Conference.

Reports of Chairman, Members and of Secretary.

The next bulletin was then discussed. It was recommended that the outline as suggested by the Secretary be approved, but that the members might make such additions as they thought advisable later.

Resolved: That the next bulletin of the Board contain,—

Personnel of Board and Institutes with a few notes.

Papers by members.

Accounts of Flower Shows.

Reports of special meetings.

Institute calendar.

Lists of available speakers and demonstrators.

Lists of new economic and agricultural publications.

Names of papers which publish accounts of **work** in Institutes.

A further discussion of the flower shows took place. The plan of the Summerland Institute of **having** a women's work fair in connection with the flower show was heartily approved. Mrs. Watt stated that the Colwood and the Mechosin Institutes and the Langley Institute and several others had the same idea, an exhibition of women's work, although it in some instances took the part of a sale of work. All the members expressed their personal gratification with the success of the flower shows and stated that they felt that this was a matter in which the Board could fairly claim to have been of benefit to the Institutes and their neighborhoods.

Mrs. Kilby hoped that there would be some way by which the beautiful books sent out by the Department as prizes would be again bestowed. The garden pictures were a great inspiration. It was also felt that the Institutes ought to be notified this fall of any prize award so that really good fairs could be given. Many Institutes intended holding an annual show and approval of the idea could be expressed.

Resolved: That it be recommended to the Institutes that their exhibition work may well take the form of an annual exhibit of women's work and flower show.

Resolved: That the Department be asked to continue the giving of books as prizes and also a per capita grant to Institutes holding fairs

A letter from the Cranbrook W. I. was read asking the Board to recommend an official ribbon. This Institute has already had pins made before the official pin was ordered and wished now to use their own pins and felt that the use of an official ribbon in addition would make the Institutes in line. The Board regretted that this Institute was thus hampered but agreed with Mr. Scott that the cost of the ribbon would be much greater than the cost of the pins to the Institute. It was then moved,—

Resolved: That the low cost of the official pins be pointed out to the Cranbrook Institute, a sample pin be sent them and that the Institute be urged to come in line with the others.

The difficulty of getting full information about the Institutes was brought up by the Secretary and after discussion it was moved,—

Resolved: That the Department be asked to notify the Secretaries of Institutes to send in their reports in triplicate, one copy for the Department, one for the Secretary of the Advisory Board, and one for the member of the Board in the district.

Mr. Scott brought to the attention of the Board the manner in which returns were made to the Department and stated that the returns were not made to his satisfaction and that he thought the members of the Board might help in this matter by fully explaining to the Institutes just what was required by the regulations and the ease with which proper

returns could be made if the printed forms were used. He instructed the members to take with them copies of the forms and draw the attention of the Secretaries to their use.

A further discussion on the Farm Congress took place and the resolution to ask for the Secretary to be sent as the official representative of the Province was passed and the Secretary asked to transmit it to the Minister through the Superintendent. Mrs. Watt, however, dissented from the motion, stating that the Chairman ought first to be given the opportunity. Mrs. Lipsett stated that were Mrs. Davies present she would endorse the motion, since it was necessary that whoever should go would be a good speaker and familiar with agricultural conditions in the Province as well as Institute work. Mrs. Kilby repeated that the matter ought to be gone on with at once and as Mrs. Davies' return was uncertain and that it was unlikely that she would wish to leave home again, she considered the recommendation as made should stand. The motion passed, Mrs. Watt dissenting.

Resolved: That the Minister be asked to send the Secretary of the Board to the Congress of Farm Women as the official representative of the Province.

It was pointed out by Mrs. Watt that as there was no annual convention as yet of Women's Institutes, it would be a good thing to let the Institutes know of the Congress since some of them might be in a position to send delegates. All the Institutes were entitled, as would be seen by a reference to the call, to send delegates, and she was sure that any Institute sending a delegate would receive great inspiration on her return. Mrs. Lipsett agreed and thought it ought to be understood that if the President wished to go that the Institute ought to make an effort to send her or the Secretary. It would depend on which could bring back the best report. But this was of course for the Institutes to decide.

Resolved: That the Secretary have an invitation sent to each Institute through the Secretary of the Farm Congress, that is one of their Convention calls.

Resolved: That the attention of the Institutes be called to the Congress and information as to rates sent them.

In the matter of the Dominion motto and badge, the Secretary reported what had been done, and it was moved,—

Resolved: That the Secretary keep on working at the matter until the Provinces are all in line.

The matter of a Dominion Council as suggested for Institutes of all the Provinces was held to be a good idea, but somewhat in advance of the times since organization was not yet complete in all the Provinces.

Resolved: That the idea of a Dominion Council be considered later, when there were Women's Institutes in the other provinces.

The members also wished to go on record as approving the having of women on such commissions as were inquiring into matters of interest

to women, such as a commission inquiring into agricultural conditions, into technical education for boys and girls in the country, and so forth, but no formal resolution was moved as there was no Commission being appointed at present which would be of large enough personnel to include women.

It was also wished to encourage in some way the interchange of visits between Institutes and inquiries were made of Mr. Scott as to whether it would be possible to secure cheaper rates for members thus going from one Institute to another. He explained that the special rate the Department secured was for lecturers only.

It was also asked if the Department would pay transportation of any lecturers outside of those in spring and fall tours, but Mr. Scott said that the Department were doing all that could be expected when they bore the expense of the regular speakers. It was not thought advisable to do everything for Institutes. They ought to help themselves. The Board agreed with this position.

Afternoon Session, August 6th.

The Secretary called the attention of the Board to the results of the testing of new household appliances in the Good House-keeping Experiment Station and the publication of their Bulletin, embodying the results of their year's work. It was suggested by Mr. Scott that it would be well to have this Bulletin in the hands of Institutes, and the Secretary was instructed to estimate the cost of having one sent to each Institute. A further discussion took place on the improvement of late years in regard to household appliances and the establishing of Home Experiment Stations, Model Kitchens, and so forth was dwelt upon.

The Secretary reported that the official pins were now on the way and the members expressed pleasure at the final accomplishment of this work.

The Secretary expressed dissatisfaction with the amount of space given the B.C. Institutes in our official organ. She reported having forwarded papers from members, accounts of entertainments, meetings, etc., and that up to date nothing had appeared save the first introductory notice. She was instructed to write the proprietor that unless a page could be given with the heading wished for, that the Women's Institutes of B.C. would be obliged to get another organ. Copies of publications desiring news of Institutes were laid on the table and also some paper cups and towels which the Board considered admirably adapted for the use of rural schools. It was moved,—

Resolved: That the Institute be informed of the present low cost of paper cups, towels, etc., and the hope expressed that they might be able to induce their use for sanitary and hygienic reasons in the rural schools.

An interesting discussion took place on the need for the instruction of girls in the country in Domestic Science, and it was resolved to try and get the Minister of Education to take some steps in this regard.

Resolved: That an officer of the Advisory Board with others, the women members of the Vancouver and Victoria School Boards, wait upon the Minister of Education and ask that: (a) training at the normal schools include domestic science; (b) that at least partial domestic training be given at rural schools.

The Institute Competitions as suggested by Mr. Scott and of which the details had been worked out at his instruction by the Board were then discussed and the details agreed upon. The recommendations were left to be embodied in a further detailed report and the hope expressed that an early intimation might be given to the Institutes so that there will be plenty of time for those entering to prepare work. Mr. Scott said that the prizes in the case of Institutes would likely be books up to a fixed amount, in order that the nucleus of a library might be had. The individual prizes might be money, but he had not yet decided.

Morning Session, August 6th.

Mrs. Watt in the chair; Mrs. Kilby, acting Secretary.

The first matter taken up was the consideration of the use of part of the Federal Grant in the establishment of a Farm Settlement for women. Mrs. Watt explained in detail the proposition made by the Colonial Intelligence League through the Hon. Mrs. Grosvenor to the Government. The members thought the idea an excellent one and that the benefits to the Province ought to be unquestionable. The imperial aspect of the matter ought not to be un-noted. The scheme was mutually of benefit to the Mother Country and to Canada.

Mrs. Lipsett considered that the greatest care ought to be exercised in the selection of the girls sent out. Mrs. Watt felt concerned that the previous training ought to be commercial as well as scientific, but Mr. Scott said he had seen the girl farmers being trained and he felt satisfied that the training was excellent. Mrs. Kilby thought that the first settlement ought to be near the capital and if it were successful that others might be established.

After the subject had been carefully talked over from many points of view the following recommendations were made and embodied in a report to the Minister. (Report subjoined). The following motion was passed,—

Resolved: That the first settlement farm should be within twenty miles of Victoria for reasons set forth.

The Board then took up the matter of the salary of the Secretary and made a recommendation to the Minister in this regard. The work of the Secretary had proved to be much greater than had been at first anticipated and with the natural growth of Institutes would prove to be still greater. The Secretary stated that there had been over one thousand letters to deal with besides the press and special reports and so forth. It was difficult to do the work without a typewriter and proper filing cabinets. Mrs. Lipsett agreed and also stated that in her opinion the official matters dealt with by the Secretary should be typewritten. Mrs. Kilby concurred and it was moved,—

Resolved: That the Department be asked to supply the Secretary with a typewriter and proper filing conveniences.

The matter of reports from lecturers was discussed and it was moved,—

That in view of the valuable information which should be gained, that it be, resolved: That extra time be given the lecturers to make up their reports and that reports be considered part of their work and be required from each lecturer and demonstrator.

Mr. Scott spoke of the inauguration of the new W. I. at Hazelmere, and stated that it was his intention to ask the nearest member of the Board to be present at an inaugural meeting so as to speak on Institute work and give the help at the outset that a new Institute was sure to need. He instructed Mrs. Watt, as Mrs. Davies was absent, to attend the inaugural meeting of the Hazelmere Institute.

He also brought up a letter from the Matsqui Institute, asking him to attend the flower show there and to send some one to speak on the value of flower shows. He instructed the Secretary to find some one to go and speak on the value of flower shows. Mr. Scott thought that some one could be secured in Vancouver, and the Secretary was directed to get some one from there if possible.

The matter of there being a need for a better knowledge of procedure among Institutes was discussed. It was decided to ask if it could be recommended to the Institutes to have at hand some authority on procedure. Mr. Scott thought it would be possible to have them provided with a work on order and conduct of meetings and so forth if the cost were not too great. He instructed the Secretary to submit estimates of various works. Mrs. Watt thought that the Year Book of the L. C. W. gave in a condensed form all the necessary information. It was a compilation from the Canadian authority, Bourinot.

Morning Session, August 7th.

The first business taken up was the examination of the qualifications of the lecturers and demonstrators who had applied to the Department for work of this sort, and of others who had been recommended by Institutes or private members. The members expressed gratification that there was such a good list of available speakers now in the Province. It was finally decided to recommend for the fall itinerary certain lecturers and to publish a list of others who would be available and whom the Institutes could themselves secure as they so wished. The list of speakers was then carefully drawn out and the following recommendations were made.

Resolved: That wherever possible and in subjects where there are professional standards, that only those lecturers and demonstrators who have academic or professional standing should be secured for fall or spring itineraries.

Resolved: That the members of the Board investigate the suitability of those who are recommended from their localities and that until such

recommendation is made that these names be not included in the list of available speakers.

Resolved: That the thanks of the Board be tendered to Hon. Mr. Burrell for sending Miss Gerrard, and that he be asked to let the Board have from time to time the names of suitable lecturers whom he knows of as coming to this Province.

Resolved: That it be recommended for the fall itinerary that the services of a dressmaking expert be secured who would demonstrate for two days at each Institute and that in conjunction with her lessons there be secured a pleasant speaker on some contrasting theme who would relieve the strain of the lessons.

The Secretary explained that the dressmaker might have to be advertised for, but that the speaker on Patriotism and Civic Work could be secured in Vancouver or Victoria where there were several good speakers available. Mr. Scott thought this a good idea and the Secretary was authorized to get a list of dressmakers and speakers and report later. Mrs. Townley, of Vancouver, was mentioned as an especially pleasing speaker, and the Secretary was instructed to write her and also to insert advertisements in Vancouver and Victoria papers for an expert dressmaker.

It was further recommended by the Board that an alternate lecturer and demonstrator be named in the event of the dressmaker and Mrs. Townley being not available, or secured. A further recommendation was then made,—

Resolved: That as alternate the services of Miss Hadwen be secured to demonstrate on Household Appliances and Management, and those of Miss Elizabeth Cruickshank, of Matsqui, to speak on the extermination of flies and mosquitoes with demonstration and lantern slides.

Mr. Scott spoke on the time of the fall itinerary, pointing out that it must not clash with the fall fairs nor yet run too close to Christmas.

The last resolution on this subject was,—

Resolved: That a list of speakers as drawn up with such additions as may be made on the recommendations of the Board, and published in the new Bulletin.

It was also considered that the list should be in the hands of the Secretaries of Institutes as soon as possible and the Secretary was instructed to send a list to each Institute as soon as completed.

The consideration of the Rules and Regulations was the next work. All the recommendations which had come in from members of the Board and from Institute officers as to changes were carefully gone into and a report drawn out and presented to the Superintendent.

Mr. Scott then fully discussed the report and its various suggestions. The recommendations were for the most part approved and the few cases where Mr. Scott thought the change or addition unnecessary were set aside.

The Secretary was then instructed to submit a full report in writing embodying what had been agreed upon and to redraft portions as instructed and to make such additions as the Superintendent considered in the best interests of the Institutes.

A synopsis of the deliberations of the Board was then presented and Mr. Scott took up the recommendations seriatim and gave such instructions as to their carrying out as seemed to him advisable.

Mr. Scott then addressed the Board. He complimented them on the work accomplished during their first year, stating that if this were an earnest of the future, he would expect great things from their work in the next few years. He explained that it was not the intention to change the personnel of the Board so long as satisfaction was being given. He considered that the recommendations made had been carefully considered and the demands made had been moderate. Much of the work had been done at slight expenditure, but he now felt justified in making greater expenditure possible. There was more money available and he felt no hesitation in confirming what the Minister had said that when it could be shown that beneficial results would ensue from expenditure, that the money would be forthcoming. Although the Institutes had really been legally organized only last year and the Board had been in existence only during the year, he was more than pleased with the progress made. He instructed the members to pay such visits to Institutes as seemed to them advisable without special instructions. He confirmed what had been the understanding that when the members left home on official business their expenses would be met and their time remunerated at the Institute rate of payment. He stated that the Secretary's salary had been fixed by the Minister and that her visits would be paid for as in the case of the other members. He explained the special work as to competitions, fall fair work and other business, which he wished the Board to go into more thoroughly. He closed by wishing the members a pleasant journey and a good year's work.

The members expressed their great gratitude to Mr. Scott for the manner in which he made the work progress, for his courtesy and most kindly dealings with the Board and Institute workers.

The meeting then adjourned.

RECOMMENDATIONS OF BOARD.

Re Farm Settlement for Women and Federal Grant.

August 14th, 1912.

1. That a proportion of the Federal Grant be used every year in the encouragement and assistance of women wishing to engage in agricultural pursuits, although not necessarily in the same specific manner as designated for this year's.

2. That a farm settlement for women be established along the lines proposed by the Colonial Intelligence League of London, England, and that, if deemed advisable, the co-operation of this organization be secured.

3. That it would seem the best plan of expending the money available for the Province to purchase the necessary land, erect the necessary buildings, and lease the same (at a nominal rental) to the Colonial Intelligence League, or some similar organization equally worthy, which would furnish, equip and maintain the settlement. The Province would be thus protected against possible loss since it would own the land and permanent buildings.

4. That it be provided for that women and girls from British Columbia or other Provinces of Canada would be able by suitable and fair financial arrangement (mutually agreed upon by the Province and Colonial Intelligence League or other organization) to participate in the benefits of such Settlement.

LECTURERS AND DEMONSTRATORS AVAILABLE FOR WOMEN'S INSTITUTE WORK.

The following speakers and demonstrators residing in British Columbia are available for lectures and demonstrations to the Women's Institutes of the Province. The Secretaries of the Institutes can communicate with these ladies at the addresses given and make arrangements directly with them for any work of this nature, which the Institute may decide to take up. Many of the Institutes desire to secure speakers from elsewhere at some meeting of the year, and the list is published for their convenience. The Department of Agriculture takes no responsibility in the matter of their extra speakers other than that the Advisory Board has compiled the list and has investigated the qualifications of the lecturers and is therefore in a position to give any further information desired.

The Members of the Advisory Board—Organization and Work of Women's Institutes.

Mrs. W. V. Davies, Chilliwack, B.C.

Study Courses.

Mrs. A. T. Watt, M.A., William Head, B.C.

Literary Talks, Libraries.

Miss Bessie Livingstone, Graduate Domestic Science School, Boston and New York School of Cookery, P.O. Box 1326, Vancouver, B.C.
Cookery, Domestic Science.

Mrs. S. Davies, Graduate Warwick Agricultural College for Ladies, 210 Grant Street, Vancouver, B.C.

Poultry, Dairying, Floriculture, Market Gardening.

Miss Sibylla Hadwen, Graduate Macdonald College, Guelph, Ont., Graduate St. Luke's Training School for Nurses, S. F. Amblecote, Duncan.
Domestic Science, Cookery, Nursing.

Mrs. E. Norman, Mirror Lake, B.C.

Canning of Fruits, Vegetables, Meats, etc.

Miss M. Pettit, Nelson, B.C. (Available Holidays). Graduate Lilian Massey School, Household Science, Toronto University, Nelson, B.C.

Domestic Science, Cookery.

- Mrs. C. R. Townley, 501 Hastings Street, Vancouver, B.C.
Civic Work for Women, Patriotic Lectures, Gardening.
- Mrs. Gillespie, Summerland, B.C.
Evolution of the Kitchen.
- Mrs. H. E. Macgill, B.A., M.A., Mus. Bac., 1492 Harwood Street, Vancouver.
Procedure and Conduct of Meetings, Women's Organizations in Vancouver.
- Miss Olive Atchison, Tynehead, B.C.
Sanitation, School and Home.
- Mrs. J. S. Drummond, B.A., 2624 8th Avenue, Vancouver, B.C.
A Women's Poultry and Fruit Farm, Our Native Trees, Opportunities for Girls.
- Miss Bessie Cruickshank, Matsqui, B.C.
Pure Food, Extermination of Flies and Mosquitoes, Laws of B.C. Relating to Women.
- Miss M. S. Wells, Victoria, B.C.
First-class Diploma, Battersea Polytechnic, London, England.
Dressmaking, Millinery, Plain Needlework.
- Mrs. Jenkins, Fernwood Road, Victoria, B.C.
Procedure at Meetings, Women on School Boards, Women's Organizations, Victoria.
- Miss Mabel Rivington, Vancouver, B.C.
Sewing Demonstrations.
- Mrs. Evans, Salmon Arm, B.C.
Orchardist.
- Miss Catherine Moule, Salmon Arm, B.C., Graduate Lilian Massey School,
Domestic Science.
Domestic Science.
- Miss Gerrard, Royal Oak P.O., B.C.
Dairying for Women, the Travelling Dairy, etc.
- Mrs. Hutchinson, Royal Oak, B.C.
Musical Kindergarden, School Gardens, W. I. Competitions.
- Miss Elsie M. Hockin, P.O. Box 556, Kelowna, B.C.
Dietitian.
- Mrs. Smith, Cranbrook, B.C.
Domestic Science.
- Mrs. Atkinson, Nelson, B.C.
Nursing, Motherhood.
- Miss Taylor, 314 Fourth Street, New Westminster, B.C.
Dressmaking Demonstrations.
- Mrs. A. L. Stacy, Burgoyne Bay, Salt Spring Island, B.C.
Dressmaking Demonstrations.
- Miss Violet Stebbings, Vancouver Heights P.O.
Household Hygiene, etc.
- Miss C. Thomas, Princeton, B.C., Late Lecturer Middlesex County Council,
England.
Nursing and Hygiene.

CALENDAR OF WOMEN'S INSTITUTES OF BRITISH COLUMBIA.

- Agassiz W. I.—President, Mrs. H. Fooks, Agassiz; Secretary, Mrs. A. E. Ogilvie, Agassiz. Meetings, I.O.G.T. Hall, Agassiz, 3rd Thursday, 2.30 p.m.
- Boundary.—Secretary, Mrs. D. Thompson, Greenwood.
- Burton City.—President, Mrs. Clark Marshall, Burton City; Secretary, Mrs. R. Islip. Meetings, Members' Homes, 2nd Wednesday, 3 p.m.
- Central Park.—President, Mrs. Bell, Britcola; Secretary, Mrs. Hadfield, Britcola. Meetings, Central Park Hall, 3rd Thursday, 3 p.m.
- Colwood.—President, Mrs. Bickford, Langford P.O.; Secretary, Mrs. Hall, Colwood. Meetings, Hall, Colwood, 3rd Monday, 3 p.m.
- Comox.—President, Mrs. Wm. Duncan, Sandwick; Secretary, Mrs. W. J. Carroll, Courtenay. Meetings, Sandwick, 2nd Wednesday, 2.30 p.m.
- Coquitlam.—President, Mrs. R. D. Irvine, Coquitlam; Secretary, Mrs. John Smith, Norfolk House, Coquitlam. Meetings, Council Chamber, last Wednesday, 3 p.m.
- Cloverdale.—President, Mrs. R. B. Whiteley, Cloverdale; Secretary, Mrs. A. P. Currie, Cloverdale. Meetings, Hall, Cloverdale, 1st Thursday, 3 p.m.
- Chilliwack.—President, Mrs. W. V. Davies, Chilliwack; Secretary, Mrs. D. H. Day, Chilliwack. Meetings, W. I. Rest Room, Chilliwack, 3rd Thursday, 3 p.m.
- Cranbrook.—President, Mrs. B. Palmer, Box 95, Cranbrook; Secretary, Mrs. John Shaw, Box 442, Cranbrook. Meetings, Carmen's Hall, Cranbrook, 1st Thursday, 3 p.m.
- Duncan.—President, Mrs. Hayward; Secretary, Miss Hadwen. Meetings, Miss Clark's Home, Duncan, 2nd Tuesday.
- Gordon Head.—President, Mrs. Watson, Gordon Head; Secretary, Miss Annie Somers, R.M.D., No. 4, Victoria. Meetings, Hall, Gordon Head, 2nd Friday, 3 p.m.
- Hazelmere.—President, Mrs. T. D. Tucker; Secretary, Mrs. M. J. Hardy. Meetings, Union Church, 2nd Thursday, 2.30 p.m.
- Kaslo.—President, Miss Mildred Twiss, Kaslo; Secretary, Miss Katie Milton, Mirror Lake. Meetings, City Hall, Kaslo, last Friday, 2.30 p.m.
- Ladysmith.—President, Mrs. Gilchrist, Box 108, Ladysmith; Secretary, Mrs. H. B. Dier, Box 92, Ladysmith. Meetings, Odd Fellows' Hall, last Saturday, 2.30 p.m.
- Lake Hill.—President, Mrs. S. D. Tolmie, Box 226, Victoria; Secretary, Mrs. W. Palmer, Lake Hill P.O. Meetings, Schoolhouse, 3rd Monday, 3 p.m.
- Langley.—President, Mrs. D. M. Coulter; Secretary, Mrs. A. Kent. Meetings, Town Hall, Langley, 3rd Tuesday, 2.30 p.m.
- Matsqui.—President, Mrs. S. Cruickshank, Matsqui; Secretary, Mrs. Lesta E. Wright, Matsqui. Meetings, Hall, Matsqui, 2nd Wednesday, 3 p.m.
- Metchosin.—President, Mrs. Wm. Sweatman, Metchosin; Secretary, Mrs. J. H. Smart, Metchosin. Meetings, Metchosin Hall, 1st Tuesday, 2.30 p.m.
- Mission City.—President, Mrs. H. B. Walton, Mission City; Secretary, Mrs. H. M. Abercrombie, Mission City. Meetings, Council Hall, 4th Thursday, 2.30 p.m.
- Nakusp.—President, Mrs. R. A. Quance, Nakusp; Secretary, Miss Bessie Abriel, Nakusp. Meetings, Members' Homes, 2nd Wednesday, 3.30 p.m.
- Nelson.—President, Mrs. J. T. Black, Nelson; Secretary, Dr. Isobel Arthur, Nelson. Meetings, W. I. Room, corner Ward and Victoria streets, Nelson, 1st Tuesday, 3 p.m.

- Penticton.—President, Mrs. McGregor, Penticton; Secretary, Mrs. Frank Richardson. Meetings, 2nd Thursday, 3 p.m.
- Royal Oak.—President, Mrs. M. Hutchinson, Royal Oak; Secretary, Mrs. J. R. Carmichael, Royal Oak. Meetings, Hall, Royal Oak, 2nd Tuesday, 3 p.m.
- Salmon Arm.—President, Mrs. P. Owens, Salmon Arm; Secretary, Mrs. W. P. Rich, Salmon Arm. Meetings, Members' Homes, 3rd Thursday, 3 p.m.
- Salmon River Valley.—President, Mrs. W. J. Andrews; Secretary, Mrs. H. E. Thompson. Meetings, 2nd Thursday, 2.30 p.m.
- Summerland.—President, Mrs. G. J. C. White, Summerland; Secretary, Mrs. G. Anderson, Summerland. Meetings, Men's Club Parlor, 3rd Friday, 3 p.m.
- Sumas.—President, Mrs. Bowman, Huntingdon P.O.; Secretary, Mrs. W. H. Hadden, Huntingdon P.O. Meetings, Huntingdon, 2nd Tuesday.
- Sooke.—President, Mrs. John Murray, Sooke; Secretary, Mrs. French, Sooke. Meetings, Schoolhouse, 1st Monday, 3 p.m.
- Tynehead.—President, Mrs. Bothwell; Secretary, Mrs. S. W. Atchison. Meetings, Member, Homes, 2nd Wednesday.

CONGRESS OF FARM WOMEN, 1912.

Report of Official Representative From B.C. Women's Institutes.

In accordance with your instructions I attended the session of the International Congress of Farm Women at Lethbridge in October, 1912. There were present from Women's Institutes of B.C. eight delegates—Your official representative, Mrs. A. T. Watt; Mrs. R. L. Lipsett, member of the Advisory Board; Mrs. Hutchinson, of the Vancouver Island Institutes; Mrs. Palmer, Mrs. Gill, and Mrs. Smith, of the Cranbrook Institute; Miss Twiss and Mrs. Turpin, of the Kaslo Institute. The delegates elected Mrs. Lipsett to represent them on the nominating Board of the Congress. Mrs. Watt was named on the Committee on Resolutions named by the President of the Congress. The delegates all took notes and will report to their Institutes. They attended all sessions, took a marked interest in the proceedings, entered into some of the discussions and made a favorable impression upon the Congress.

GREETINGS.

I had the privilege of extending to the Congress a few words of greeting from the Deputy Minister of Agriculture and Superintendent of Institutes, B.C., expressing his best wishes for the success of the Congress. He said that a noble work was being undertaken for the improvement of conditions of rural life, and that such had his warmest support. He hoped that the work undertaken by the Women's Institutes of British Columbia would be found in line with the most progressive movements elsewhere. His greeting was warmly received, and a tribute paid to Mr. Scott for his co-operating in the line of women's work, of which he is the official head.

MEETINGS.

The meetings of the Congress were full of interest. The subjects dealt with concerned all kinds of women's work. Attention was directed to the farm home, to child-welfare, to agricultural education, to kitchen

equipment, to young people, to Women's Institutes, to women farmers, and to various problems of Home Economics. The most notable address was that given by Dr. Liberty Bailey on women's part in the country life movement, although many papers of equal interest were provided. There were several speakers from this Province: Miss Ravenhill, who spoke on foods and care of children; Mrs. Hutchinson, who spoke on Musical Kindergarten; Mrs. Norman, who gave a demonstration on the home canning of fruit, vegetables and meat; and Mrs. Watt, who reported on the work of Women's Institutes in Province.

GENERAL IMPRESSIONS OF THE CONGRESS.

No one could fail to be impressed with certain general aspects of these series of meetings.

RURAL SCHOOLS.—The matter of the education of the country boy and girl was made a prominent feature of nearly all the addresses, and evidently was felt to be a movement of the deepest importance to the future farm life of the continent. Speaker after speaker pointed out that in the matter of technical training and teaching for home-makers the country schools were behind the times. It was impossible to avoid the conclusion that Departments of Agriculture and Agricultural Colleges are providing courses in Home Economics, because the Public Schools had failed to recognize the needs of the children in the country. It was pointed out that unless the country boy and girl were able to receive technical instruction, or instruction in Home Economics in the rural schools, it was hopeless to expect the country school to turn out farmers and home-makers. It was urged with the greatest emphasis that the rural schools needed regeneration, and it was pointed out that this was the plain duty of women's organizations in the country to make over the country school both inside and out, and revise its character until it was in line with modern educational demands.

In his report, Mr. Putnam, of the Ontario Women's Institute Branch, who is undoubtedly a great authority on the work of farm women, made a special point of the Women's Institute work for country schools. He stated numerous examples of cases where the Institute had been able to make a good school from a poor one, and advised further work along these lines. Women teachers from various colleges also spoke on this matter and most unsparingly condemned the inadequate equipment, unlovely surroundings and insanitary conditions of country schools. They stated that the courses in Home Economics for growing girls had been the greatest feature for good in modern education. Distinction was made between Home Economics and Domestic Science, and it was pointed out that Domestic Science was the lesser term with the meaning generally attached, but that Home Economics included everything pertaining to the home.

PROGRESS OF FARM WOMEN.—The wonderful progress made in mental and social equipment by the farm women was made evident at every session of the Congress, and is the more remarkable as the women who are the present day makers of farm homes are not those who have themselves had the benefit of modern educational methods. They have

imbibed that which is making them successful and up-to-date, from several sources, and none of them directly in the first place. The distribution of literary matter by the various Agricultural Departments and Agricultural Colleges, by Household Experiment Stations, Schools on Home Economics, and so on, make an appreciable difference in the reading matter of country homes. Then, too, the Women's Magazines and the Home Department of Agricultural papers, while there is still room for great improvement, are more scientific and more interesting than they were some years ago. The daughters are now returning from Colleges where Home Economics play a part in the curriculum and are bringing to their mothers the results of their studies. A great factor is the formation of rural home organizations. Country women are receiving by these meetings courses in technical education and the more energetic women are taking full advantage of all these opportunities. It was perfectly plain at this Congress that an upward and onward movement was in full swing among farm women, and this fact, so important to the life and growth of the future race, is the greatest guarantee of the continuance of country life. It must be apparent to the most casual observer that agricultural development both in Canada and the United States is dependent upon the women who maintain homes in the country. The permanent settlement of the country demands homes and the importance of improving the conditions of rural home life was acknowledged by all the men speakers. The Minister of Agriculture for the Dominion, Hon. Martin Burrell, stated that the national prosperity depended upon the country home. The President of the Dry Farming Congress, Mr. Widsoe, said that no work more important devolved upon the nation than the preservation of rural home life.

SCIENTIFIC HOUSE-KEEPING.—Possibly more emphasis was directed at this Congress than will be the case at future ones to scientific house-keeping. By the time of another Congress it will be pretty generally recognized that farm homes all over our continent are equipped for scientific house-keeping, and that such as are not so equipped are not thus for lack of knowledge but for other reasons. The most up-to-date methods in home-making were discussed, chiefly from the point of view of labor and time saving devices. Papers were given dealing with kitchen equipment, laundry and cleaning methods and such modern household appliances in water supply, heat and light as can be undertaken in conjunction with farm machinery. The future prospect of co-operation between farm and domestic machinery was discussed, as was also that of the members of the family on the farms. Your delegates were pleased to note that all of these household improvements had been discussed in our Institutes. Further than that all the up-to-date literature on these subjects spoken of at this Congress had been in the hands of the Secretary of the Advisory Board of B.C.

PROGRAMME.—The programme for these eight sessions of the Congress was very full and the general comment was that there were too many papers and too little discussion. No doubt considerable difficulty was found by the officers in arranging that the different organizations of the country should be represented, but some of the papers might have

been left out to advantage and more discussion allowed. The discussions were of great interest to your delegates, and the fact that many farm women can speak so well in this impromptu manner, on subjects requiring some special knowledge, was pleasing and significant. The standard of the programme was, I think, on the whole, not so high as that of Conventions in Eastern Canada. It is likely that by another Congress a better programme can be arranged. It is no easy task to select from an abundance of material and there were so many notable speakers present at the Dry Farming Congress that it was felt that not to take advantage would result in great loss. This also added to the congestion.

DISTINGUISHED SPEAKERS.

There were many prominent men and women at the Farm Women's Congress as well as the Dry Farming Congress. It was gratifying to note the hearty co-operation of men in the work of the Farm Home. Many expressions of regret were heard that the Hon. Price Ellison could not have spoken at the Congress and the Conference. It is plain from the speeches made that there exists and will exist to a greater degree strong and willing co-operation between men and women farm workers, and home-makers. I cannot help telling of the great personal pleasure it gave me to listen to speakers from such widely different localities, to the eloquent Persian, His Excellency Kuli Khan, to Dr. Aaronson, of Palestine, on the work of women in the Holy Land, and to Dr. Bailey, whose books are so valued by all horticulturists.

CHILD WELFARE.

It was thought fitting that a day of this big Congress should be given to child welfare, and everything relating to children was talked of by mothers and teachers, including the new science of Eugenics, care and feeding of children, the special education of country boys and girls, the general trend of discussion seemed to be that hygiene is recognized as a prime necessity. The basis of sound health was insisted upon and everything which would point to loss of strength or growth was decried. There seemed to be a better understanding of the needs of young children for rest, quiet, and simple fare, and all advice on this matter was greatly sought for. The old idea that people are born mothers and nurses seemed to have passed away and the young mothers seemed especially anxious to get all new and important information.

WOMEN IN OFFICIAL LIFE.

Considerable interest was evoked in the fact that many women in attendance at this Congress are occupying official positions in the various Provinces and States. This seemed to be regarded as a fact of importance in the proper development of work. In some States the Women's Institute Branch is a separate Department in charge of a woman superintendent. In others there are women in charge of organizations for farm women connected with the Department of Agriculture. In some cases the Extension Department of Agricultural Colleges takes charge through a woman teacher of the Women's Institutes or the corresponding organizations. It seems also generally recognized that this work is more efficiently done when there is a woman in charge of the central organization. Miss Stevens,

a graduate of Macdonald College, Guelph, is now in charge of the newly organized Women's Institutes of the Province of Alberta. Miss Dunbrack has occupied the same position in New Brunswick for some time. Mrs. McCharles is the president of the Home Economics Club of Manitoba. Miss Salisbury is Secretary. The work is done by women lecturers of the Agricultural Colleges in Saskatchewan. Mr. Greenway, of the Agricultural College, acts as supervisor, but it is expected that when this province comes into line with others in Women's Institutes, some change will have to be made; either an Advisory Board, as in B.C., will be appointed or a woman officer in the Department. Considerable interchange of experiences and methods in vogue was made among these women officers and it was a pleasure to meet these women, most of them with fine executive ability, with keen local pride in their work and with special educational equipment. And it would seem as if the proper outlet had been found for the activities of these specially trained and capable women in the official positions they are now occupying in Departments of Agriculture and Extension of College work among farm women.

INTEREST IN BRITISH COLUMBIA.

Your delegates found that a great interest was displayed in British Columbia. The fame of the Province seemed to have spread all over the continent and indeed the delegates from all over Europe and Asia seemed equally conversant with the fact that the far western Province of the Dominion is of unusual value to the country life movement. No doubt the wonderful fruit exhibit of the Province and its beautiful arrangement contributed largely to this interest. There was a great demand for literature from the Province and a list has been forwarded to the Secretary of the Department of Agriculture of some women who were specially anxious to receive our literature. The strength, too, of our delegation gave the idea that great interest existed in B.C. for the work among country women. Then, too, the organization of our central workers seemed to attract attention. The fact that an Advisory Board of four women were connected with the Department of Agriculture seemed to many of the workers to present an effective solution to the problem of central workers and official connection. It was explained that the geographical conditions of the Province made a division of this sort practicable.

MRS. WATT'S ADDRESS.

The address of the Secretary of the Board on the Women's Institute movement in B.C. was historical, and explanatory, but there was no time to make any reflections on this movement or to enter into any discussions with other Institute workers or to point out our ideals in this regard. It was unfortunate that this paper came last thing in the Convention on the closing day and every one was tired and there was no time left for discussion. The same treatment was meted out to Mr. Putnam, but on making representation to the Secretary we succeeded in getting his most important address put on earlier.

It was freely commented on all sides that not sufficient time or attention was given to the work of Institutes at this Congress. It was

generally considered that the Institute organization for country women is by far the best of any women's organization in the country. Had more time been allowed for presenting the aims and objects of Institutes no doubt a greater spread in the movement would have resulted throughout the States, as the Institute seemed to meet the case of the farm woman better than any other rural society.

PRESS MEETINGS.

There were many newspaper women in attendance at the Congress and an International Press Association was formed of the women writers present. Your official representative and the delegate from Vancouver Island Institutes were both eligible for membership and were invited to join. Mrs. Hutchinson and I therefore joined this Association, and we hope that considerable advertisement of the Province will accrue from our connection with these women writers from all over the Continent. The meetings held were very interesting and one direct result will no doubt be the immediate improvement of the home section of Agricultural papers throughout the States and Canada. The low standard hitherto existing in this section of the country papers were heartily condemned, and all present pledged themselves to use their pens and influence for the betterment of these Women's Departments. This in itself ought to make a great difference to the conditions of country life.

A dinner was given to the representatives of the press of the whole Congress. About eighty men and women members were present. Your representative was given the seat of honor next to the Minister of Agriculture for that Province, and was able to glean a good deal of useful information regarding plans for Women's Institute work in Alberta. A short speech was given by the Minister, the Hon. Duncan Marshall, then several other brief and interesting speeches were made.

UNIVERSITY GRADUATES.

We were unable owing to the full programme to get any statistics as to the number of University women present. There were undoubtedly a large number in attendance, and we noted the importance of this fact in considering the conditions of country life. We called a meeting of graduates, but many were unable to be present. It was, however, noted that at every session there were a number of college women present, and it was regarded as a helpful sign that college trained women were giving their attention to the country life movement. Gratification was expressed that the Secretary of our Advisory Board is also a member of the Senate of B.C. The comment was made that the link was thus effected between higher education, and the problems of country women.

CONFERENCE OF INSTITUTE WORKERS.

At the suggestion of your Advisory Board, Mr. Putnam, head of the Ontario Branch, asked the Secretary of the Congress to call a Conference of Institute Workers in Canada. This Conference was held, Mr. Putnam presiding, and official representatives from almost every Province were present. It is dealt with in a separate report enclosed herewith,

MANAGEMENT AND ACCOMMODATIONS.

I regret that I cannot report favorably upon the arrangements made for the Women's Institute delegates from B.C. to the Congress, and in the opinion of the delegates, blame is not to be attached to the local authorities but to the management of the Congress. The accommodations arranged for women were insufficient and in many cases not such as ought to have been offered to any one. I make no reference to the accommodations in private homes, which naturally were of a varied character, but to that arranged for in other buildings in the city. There seemed to be no co-operation between the management of the Women's Congress and the women of Lethbridge so far as the comfort of the women delegates were concerned. Should you care to have more specific accounts of this failure to arrange proper accommodations it can easily be had from many of the delegates. We made no formal protest at the meeting as it was not our business to do so, but it would seem as if some protest should be made in the interests of what is undoubtedly a good work. The Congress of Farm Women presents wonderful opportunities but its management should be most careful and of an unimpeachable character.

HONORS TO BRITISH COLUMBIA DELEGATES.

Every disposition was shown to include B.C. in any honors which the Congress had to distribute. Your representative was elected Second Vice-President of the Congress. I was not present when election took place, as the meetings being over, I had left that morning. I regret this as I should have liked to express our gratification of B.C. being thus recognized. I went across the Continent immediately after this, and saw a great many American papers. The fact that a British Columbia woman had been chosen for one of the four officers of this great international organization was widely commented upon throughout the American papers. I hear also that Canadian papers made favorable comments. This in itself would justify the fact of your having sent delegates to this Congress.

I hope you will consider that the British Columbia delegates from Women's Institutes made the most of their opportunities and that the Province will receive corresponding benefit.

I have, etc.,

M. R. WATT,

Secretary, Advisory Board Women's Institutes, B.C.

Report of Mrs. Lipsett, Member of Advisory Board of Congress of Farm Women, 1912.

The Second International Convention of Farm Women, opened in Lethbridge on October 19th to 26th.

Following prayer by Rev. Mr. Cameron, the Cardstone Choir rendered the National Anthems of Canada, United States and England.

Welcome was extended in turn for the Dominion by Mrs. Bulyea, wife of the Lieut.-Governor of Alberta, Mrs. Marshal, for Alberta, and Mrs.

Dormer, for Lethbridge. They were united in expressing the sentiment that the coming of the Congress to Lethbridge was a great benefit to the Canadian Northwest, Alberta being the first of the Canadian Provinces to entertain a session of the Congress.

Mrs. Stavert, in opening the Congress, said: "It is my great pleasure to welcome you to Lethbridge and the sessions of this Congress, on behalf of the Officers and Executive Boards of this organization. [We deeply appreciate your presence and heartily greet you.] I want to thank the women for the sympathetic help given me in my share of the work in this Congress. The purpose of our existence is to better rural home conditions. Each nation, state, province and small community has its own particular way to solve its problems, and that is why it is good for us to come together and compare notes."

The Congress was then declared open.

Greetings were extended to the Congress by the President of the International Dry Farming Congress, Dr. John Widstoe, of Utah.

He spoke of the necessity of knowing facts concerning household management, thus making it scientific, as farming had been made scientific by the collecting of facts in that regard. President Widstoe avowed himself a suffragette, that is, he said he was perfectly willing to give women the ballot so they might go to the polls and vote for the men. He stated that the Congress needed the co-operation of the women in order to have the work done as it should be. People were realizing more and more that the work of the men would not advance unless the women were kept side by side with them. "I am not ashamed to state that I am a 'Woman's Rights man.' In our State the government has been bettered because the women have taken hold.

Miss Ravenhill, of Victoria, brought greetings from the Mother Country, assuring the people of the keen interest felt by England on all educational movements. She spoke of the importance of the interchange of ideas to develop the individual and the homes.

Mr. Kulu Kahn, Persian ambassador at Washington, D.C., representing his wife, an American lady, gave a most interesting address, telling of the part the women of Persia take in this work. He said we have wrong ideas about woman's position in Persia. They always go veiled, because it is a custom of the country, but they have as much freedom as women in other countries. They are educated and cultured. The beautiful Persian rugs we see in this country are made by women. They are wonderfully gifted in this respect and weave the most intricate designs without a pattern. He spoke of their bravery and gave an instance. Three years ago, during the war in Persia, a band of two hundred defended their position against fifteen hundred men. Eighty out of the two hundred were killed and it was found that sixty of these were women.

Hon. Neil Neilson, of Australia, brought greetings from the farm women of Australia. He said Canada is the nearest white neighbor we have. He struck a note of enthusiasm in the audience when he said there were no suffragettes in Australia. They do not need them as women

vote there, and they were given the right to vote in simple justice. It has developed into nothing but good during the twelve years it has been in operation. Clubs and societies have been organized to better the conditions of the working woman. They have succeeded in making the life of the working girls more pleasant and happier. The civilization of a country is shown by the way in which women are treated. The most progressive country is where women are co-helpers in settling the moral questions of the day. Australia is the cheapest place in the world to live. Mutton is five cents a pound, and one can get 13 loaves of bread for six cents. Clothing costs half the price it does in Canada. The reason for this is the producer and primary consumer are brought together and the services and wages of the middleman are done away with.

Dr. Aaronhson brought greetings from the women of Palestine. He said: "We are separated geographically, but our women are united in spirit with you towards the uplift of the world. You do not understand our country. Most reports of it come from visitors who consult a Guide Book, and remain with us for a day or two. Our women are good and are willing to sacrifice when sacrifice is needed. If you could see into the inner life of Palestine you would find that the women unite with the men in working for the emancipation of the world."

Miss Harkness, of Boseman, Montana, presented greeting in the form of a letter from the President of the Women's Farm Institute of Belgium.

Tuesday Afternoon Session.

Dr. J. H. Worst, President of the North Dakota Agricultural College, Fargo, spoke on "Educating the Boy for the Farm." He said: "I have never before had the privilege of speaking to so many women. I think my subject should be 'Educating the Girl for the Farm.' I am glad that the women of Canada and the United States have organized to better the conditions of farm women. Many a mother toils hard and then looks forward to the future with dread. I have thought it would be a good thing if we could eliminate some of our ancient history and algebra from our curriculum and educate along more essential lines. We teach our children to be extravagant. That one cent a day for gum he should be taught to save. Let him see that present sacrifice is future happiness. If we can teach boys they can have the modern comforts on the farm at as little expense as in the city, the boys will stay on the farms. To make the child follow a systematic principle of saving will not make him a miser. There is no growth until the seed is planted. In the United States there are 5,000,000 men in the bread line. If they took the money of five cheap cigars a day and invested it for fifty years, they could buy all the farms in the United States and pay cash for them. In order that the boy may be content on the farm, the home must be inviting and delightful with all the comforts found in any city home."

Miss Irena Matthews gave a most interesting address on "Our Farm Home." Miss Matthews is Superintendent of Oklahoma Women's Institute. She said: "So many of us know what the homes are, but so few of us know what they could be. So many know the weary routine and monotony of the farm home. There are two avenues through which our farm homes

are inspired, namely, through the father and mother. Let us hope that this Congress, made for us, by us, may continue to improve conditions among farm women. How many farm homes do we find that are sad and gloomy? There is no caste on the farm. The homes are better for each little effort. There is just as much demand for the lovely and beautiful in the country as in the city. We are striking out hospitality in the rush for dollars and cents. We can only live so much, and it is up to us to live it the best we can. God created the beautiful in us, but we let the grind of life blot it out. The broadest education is that which makes you think most of your life, your friends and your community. The less nagging we do, the bigger we are. So often the mother is separate and apart. She does the work but she cannot converse with her daughters' and sons' guests. We want to alter such conditions, until each woman is the biggest woman she can be. We need the libraries and magazines in the farm homes, and we are getting them. Civilization has come as soon as the woman has brought refinement into the home. Then our women will have learned the value of saving time and woman instead of time and money.

Miss Harkness, Professor of the Department of Home Science, Bozeman, spoke on the "Woman Who Spends." She said we hear much about the high cost of living but little about the remedy. The trouble is the principles of economics have not been studied in relation to everyday life. In Montana we are finding out the cost of living in different homes under different circumstances. Women do the greater amount of buying and the whole of home life centres about the spending of the money. We must work for pure food laws and satisfy ourselves that the workers on our clothing, etc., are under sanitary conditions and are paid aright.

On Tuesday evening the new Auditorium was the scene of a brilliant social function on the occasion of a reception which was tendered the delegates and notable visitors to the Dry Farming Congress. A pretty feature of the evening was the presence of the "Queen of the Congress," in the person of Miss Edna Hatch, daughter of the Mayor, and a train of the prettiest young girls in Lethbridge. Miss Hatch was the selection of a majority of the citizens in a contest preceding the Congress.

The walls of the Auditorium were hung with the flags of many nations, while the stage was beautifully banked with ferns.

Her Gracious Majesty, Queen of the Congress, was gowned with white satin with a crimson robe and court train edged with ermine, a jewelled tiara and a sceptre of wheat stems. The Ladies in Waiting and the two small pages fulfilled their duties well.

The Lieut.-Governors of Alberta and of Saskatchewan, with their wives, and the Provincial Members and Officers of the Congress were the hosts and hostesses, and receiving with them, in a long line, were the following delegates:

Ambassador Ali Kuli Kahn, of Persia; Senor Bradies and Senor Eschor, of Mexico; Messrs. Kol and Rosen, of Russia; M. Hsieh, of China; Mr. Coleman, of India; Hon. Neil Neilson, of Australia; Baron Lochneysen,

of Germany; Dr. Trochman, of the Netherlands; Mr. Aarnson, of Palestine; Chevalier Rossah, of France; Mr. Rogers, of South Africa, and several others. Twenty-five hundred people were in the Hall and over fifteen hundred were presented. After the reception, the Queen awarded the prizes and short speeches were made by the recipients. The famous Cardstone Choir occupied seats on the platform and rendered pleasing selections.

Wednesday Morning.

Mrs. A. M. Kepper gave an interesting address on "One Farm Woman to Another." She said farm women hold an important place in the world. They create new wealth. By their efforts the poultry industry is now a source of wealth, and millions of pounds of butter vouch for their unremitting toil. The home garden shelves, laden with filled fruit jars, bear testimony to their thrift. Farming life need not mean isolation, for no one is lonely who has the companionship of authors. By systematic reading we may get much knowledge that will serve us well. The world is an educator. Get out in it and elbow along. The farm mother has better opportunity to keep close to her boy than the mother in the city where so many things beckon. The whiff of the field is not the same that hovers over the saloon bordered sidewalk. Our boys are safe with nature as a companion. We should add beauty touches to our home. The country needs the artistic as well as the city.

Mrs. John Habert, of Colorado, read a very practical paper on "Modern Kitchen Equipment in Dollars and Cents." She said:

"I come from the rank and file of farm women who do their own work. I prepare three square meals a day, wash dishes, wash and iron my own clothes, and look after a large flock of poultry, superintend the care of a cherry orchard, which is the pride of my heart. I can fruit, vegetables and meat, and keep my home clean and neat. I find time for all these duties because I have labor saving devices in my kitchen, run by electricity. One electric motor runs the sewing machine, washes the dishes and clothes, supplies with power the ironing mangle, the electric iron, the toaster, the electric fireless cooker, at the average cost of three cents an hour. Nowhere do we find so many instances of lost motion as in kitchen work. House plans should be directly related to the kitchen labor." Mrs. Habert spoke of the desirability of plain aluminium surfaces on ranges, of an apron over the stove to carry off all odors and steams; of a color scheme pleasing to the eye; of flowers in view of kitchen windows and all the attractive points that make one want to stay there and use the equipment. All the above devices can be installed for the price of the piano in the parlor, and, if she can get these first, she can save time enough to practise on the piano later.

Mrs. Cooper, of Treesbank, Manitoba, discussed the chicken business in its different aspects, giving her experience from early pioneer days to the present time. She says her business is paying, both in the satisfaction you can get out of producing such necessary products, and it also pays well financially. Mrs. Cooper exhibited some useful devices in the way of coops, trap nests, etc.

Mrs. Howie gave a very interesting and impromptu talk on dairying. She gave an inspiring account of her visit to an Ayrshire dairy in County of Ayr, Scotland, and also a visit to Queen Victoria's dairy.

Wednesday Afternoon Session.

Dr. Bailey, of Cornell University, gave a splendid talk on "The Woman's Part in the Country Life Movement." He said:

"As it takes two persons to form a family, so the efficiency of the home depends on the co-operation of both, and there must be equal institutions and opportunities for both. Women have not yet had their recognized place in education in the public schools of today. Improved farming and improved home making are needed. The woman who keeps house is the one to better farm life and to influence for good the affairs of the community. The introduction of home economics in the public school is a step towards the education of woman. Any occupation that is worth while is worth putting in the schools. The day of training women for accomplishments is past. These should come as a result of other lines. The country woman must broaden her own sphere and must master her own problems before she can solve other problems. The crude and raw should be eliminated from the farm architecture and the home must express the ideals of the woman. She should have intellectual resources in her work that would develop mind and train character."

Miss Ravenhill, of Victoria, B.C., gave an address on "Our Daily Bread." She said:

"The knowledge of the use of food to the body is necessary to the provision of suitable diet for the individual and the family. The suffering brought on by the errors of diet points to the need of more general education in this respect."

Miss Berry, of the Pullman College of Washington, talked on "Economy Functions of Home Making Women." She spoke of the necessary education to fit woman for that greatest profession on earth, Motherhood. Miss Berry brought greetings from the College and the Federation of Women's Clubs."

Mrs. Ernest Norman, of Mirror Lake, B.C., gave a splendid talk and demonstration on "Home Canned Vegetables and Meats." Mrs. Norman won the International Ribbon on her fruit and vegetable exhibit.

Thursday Morning Session.

The Congress opened with an address on "Eugenics," by Dr. Alfred Atkinson, of Bozeman, Montana. He said:

"Eugenics or the limitation of marriage to the physically and mentally fit goes hand in hand with the preservation of a nation. Studies in heredity by scientists have proved that eye color, hair color, memory, epilepsy, criminality, etc., are passed on from one generation to another. The possibility of free marriage has made many complications. He referred to "The Human Harvest," a little book by David Starr Jordan, of Stanford University. After reading this book, Mrs. Herron, a wealthy woman of the United States, gave a million dollars to expend on furthering the

cause of Eugenics. The modern age is realizing that a nation must preserve its best men and thus they cannot engage in long wars of contest. The main object of Eugenics is to create a sentiment that shall cause persons of marriageable age to choose companions of physical and mental fitness. They think those unfit should be controlled by the State.

Miss Ravenhill, of Victoria, B.C., gave an address on "Physiological Growth and Development in Childhood and Adolescence." She said:

"Man is born the most helpless among animals. The periods of growth are: (1) Infancy; (2) Early Childhood; (3) Later Childhood; (4) Adolescence. The latter is a period of change in mind and body. It is a time for training in hygiene and self control. Allowance should be made at this time for the instability consequent upon the many physical changes active at this period of life."

The afternoon session opened with a solo by Mr. Fleming.

Mr. W. L. Clark, of Leamington, Ontario, gave an interesting address on "Farmers' Sons." He emphasized the importance of teaching the boy what he should know. The keynote of his address was the necessity for purity.

Prof. Geo. Putnam, of Toronto, gave a report of the Ontario Women's Institutes. He said:

"We cannot emphasize too much the importance of high ideals in the home and which are reflected on the national life. While the field of greatest promise lies in educating the young, still we have a present duty in affording facilities for self improvement, to those who are now, and have been for years, face to face with the problems of home making and home keeping. One of the organizations which has been very successful in this line is the Women's Institute of Ontario."

Mr. Putnam outlined the beginning of this work and followed its growth and expansion into 700 branches with a membership of 21,000. Each organization is doing something towards instruction in food values, methods of cooking, care of children, sanitation in the home, and other features that bear directly on the individual and the home. The Institute is a force today because it does things on its own account. The Institutes deal with problems of interest to the community and the Province; School problems, rest rooms for women who come to town for a day, civic improvements, libraries, etc., are receiving attention, and those who are in touch with Institute work see greater possibilities ahead.

Mrs. Muldrew, Principal of Alberta's Ladies' College at Red Deer, gave an address on "Education of Girls." She said:

"As a rule we have used more wisdom with the education of our boys than with our girls. This is because we look upon our men as the producers of wealth. When a boy leaves the High School and we can afford to give him more training, we make it bear on his vocation, so that whichever line he follows, he will be a better producer of wealth. We have not used the same wisdom with our girls. Education should meet the nation's greatest need. If the training of our girls has failed

to develop executive ability, absolute honesty and independence of judgment, what shall be the result when they are thrown on their own resources? Girls should be taught they are to be educated for help in life, not for the drawing room. A love of home should be implanted in the minds of the growing girls, so that they will appreciate and understand the requirements of good homes."

Mrs. Watt, of Victoria, B.C., conveyed greetings from British Columbia to the International Congress of Farm Women. Mrs. Watt regretted that she could not deal with the subject as announced, as she felt that, as a delegate from British Columbia, she should give a report of Women's Institutes in that Province.

Mrs. Watt spoke of the expansion of the work during the past year, of the pin and its coloring as symbolic of the work of Women's Institutes; of the help sent out by the Department in the line of Bulletins and Literature; of the financial aid given the Institutes by the Department, as well as its supply of expert demonstration for the Spring and Fall meetings.

Mrs. Watt also spoke of the successful Flower Shows held by the Institutes this year and of the increased interest in consequence. Suggested competitions between the Institutes was mentioned, by which it was hoped the best in each could be developed. The first need of an Institute was a regular meeting place equipped with modern conveniences for demonstration. Co-operation between Institutes and School Boards is necessary, so that interest may be awakened sufficiently to introduce Domestic Science in the rural schools.

Rev. Matthew McNeill, of Illinois, spoke on "Modern Methods in the Country Church." He said the Church and the Farmer are two of the most important institutions in the world. Through the one the Bread of Life is dispensed and through the other the Staff of Life, food for the soul and food for the body. Unless country life deals with its local problems it becomes narrow and mean. The Church deals with ideals rather than things. Righteousness is one of these ideals. This virtue prevents men from putting the large, smooth, red apples on top of the box when there are runty scabby ones on the bottom. The world will be better when men recognize a brother in everyone they meet. bZJesus said, "Go ye," etc. We emphasize the first, and forget to live out the last part of the command. Let our lives be one of service and we will be following the example of Him who gave His Life a ministry to others.

Mr. John T. Burns, speaking for Mrs. Burns, suggested the building of a monument to the pioneer woman of the West. The idea of the monument originated with C. Christador, of Point Loma, California. The suggestion was received with enthusiasm. The model, wrapped in the Stars and Stripes and the Union Jack was uncovered. It was an artistic statue of a typical farm woman, standing at the door of her home, with one arm outstretched around the shoulders and neck of her boy, her eyes towards the horizon with a look of anxiety in her face, awaiting

her husband's return from his labor in the field. It is proposed to construct the monument of bronze and have it of massive size.

It was suggested at first that the monument be placed in the Hall of Fame at Washington, D.C., but this was thought to be too far away from the pioneer country in which the farm woman became famous. It was decided to start a contest between the largest cities of the West. Every woman on every farm in the United States and Canada may cast a vote for the location of the monument, and for each vote cast, a dime is to be subscribed to create the fund that assists in raising the \$150,000.00 that will be necessary for its completion. The idea was received with enthusiasm and a committee formed to undertake the work. The sum of \$47.50 was collected before the meeting closed.

The officers for 1913 were announced: President, Mrs. John Hubert, Colorado; Secretary, Mrs. John Burns, Lethbridge; First Vice-President, Mrs. Havert, Winnipeg; Second Vice-President, Mrs. Watt, Victoria; Third Vice-President, Miss Matthews, Oklahoma.

The afternoon session was devoted to a lecture on the economic and nutritive value of foods by Miss Bawden, of Lethbridge. An electric stove was used and each person in the crowded room was supplied with a typewritten copy of the recipes used in the demonstration. Miss Bawden, while preparing the many dishes, kept up a commentary on the economic principles of cooking on thoroughly scientific lines. Many questions were asked which showed the keen interest in the subject of Domestic Science.

About the Institute exhibits I can only remember the following: Magrath Institute had a very unique booth—a potato roof and potato fireplace, vegetable vases and jardinières made of turnips and carrots scooped out. Their exhibit included home work, needle work and domestic arts.

There was a collection of work from a Home Economics Society in Manitoba which got first prize.

Mrs. Norman, of Mirror Lake, B.C., won the international ribbon for an exhibit of canned meat and fruit.

Miss Twiss, of Kaslo, B.C., won first prize for the best exhibit of fruit and jelly in glass by farm women of one neighborhood. I am not sure the Institutes were represented in the latter exhibit.

Cardstone, Alberta, Institute had a fine booth under the grandstand—needlework, home cooking, painting and candy making were included in this exhibit.

NOTICE.

The Department of Agriculture is issuing the following series of bulletins prepared by Miss Alice Ravenhill, Shawnigan Lake, B.C., to be available for distribution among the members of the Women's Institutes throughout the Province:

- No. 35.—The Place and Purpose of Family Life.
- No. 36.—The Preparation of Food.
- No. 37.—The Preservation of Food.
- No. 41.—Some Labour-saving Devices in the Home.
- No. 46.—Food and Diet, Part 1.
- No. 47.—Food and Diet, Part 2.
- No. 50.—The Care of Children (to be issued).
- No. 43.—Women's Institute Work in British Columbia. (By the Advisory Board of Women's Institutes).

BULLETINS ISSUED BY THE DEPARTMENT OF AGRICULTURE.

- No. 30.—Guide to Bee-keeping.
- No. 32.—Control of Tuberculosis.
- No. 33.—Fruit-growing Possibilities of the Skeena River.
- No. 34.—Black-spot Canker.
- No. 38.—Construction of Silos.
- No. 39.—Natural and Artificial Incubation Brooding.
- No. 40.—Alfalfa.
- No. 42.—Apiculture in British Columbia.
- No. 44.—Irrigation in British Columbia.
- No. 45.—Agricultural Statistics, 1911.
- No. .—Tobacco-culture.
- No. .—Cultivation of Fruit-trees in Cold Climates.
- No. .—List of Poultry-breeders.
- No. 22.—New British Columbia.
- No. 48.—Exhibiting Fruit and Vegetables.
- No. 49.—Market Poultry.
- No. 51.—Information for Fruit-growers.
- No. 52.—Annual Report of the Advisory Board of Women's Institutes.

CIRCULARS.

- No. .—Fresh-air Brooders.
- No. 1.—Clearing Logged-off Lands and Char-pitting Up-to-date.
- No. 2.—Field-crop Competitions, 1912.

PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF AGRICULTURE

(WOMEN'S INSTITUTE)

BULLETIN No. 53

THE CARE OF YOUNG CHILDREN

By

MISS ALICE RAVENHILL

Fellow of the Royal Sanitary Institute, etc., etc.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1914.

PROVINCE OF BRITISH COLUMBIA

DEPARTMENT OF AGRICULTURE

(WOMEN'S INSTITUTE)

BULLETIN No. 53

THE CARE OF YOUNG CHILDREN

By

MISS ALICE RAVENHILL

Fellow of the Royal Sanitary Institute, etc., etc.

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1914.

DEPARTMENT OF AGRICULTURE,
VICTORIA, B.C., March 9th, 1914.

Hon. Price Ellison,
Minister of Agriculture.

SIR,—I have the honour to transmit herewith Bulletin No. 53, entitled
“The Care of Young Children,” prepared by Miss Alice Ravenhill, Fellow
of the Royal Sanitary Institute, etc., for distribution to the members of
the Women’s Institutes throughout the Province.

I have the honour to be,
Sir,
Your obedient servant,

WM. E. SCOTT,
Deputy Minister of Agriculture,
Superintendent of Institutes.

DEPARTMENT OF AGRICULTURE
TERRACOTA, B.C., March 29th 1911.

Hon. Peter Gillman,
Minister of Agriculture.

Sir, - I have the honour to transmit herewith Bulletin No. 23, entitled
"The Care of Young Children," prepared by Miss Alice Havershill, Fellow
of the Royal Sanitary Institute, etc., for distribution to the members of
the Women's Institutes throughout the Province.

I have the honour to be,

Sir,

Your obedient servant,

WM. R. SCOTT,

Deputy Minister of Agriculture,
Superintendent of Institutes.

THE CARE OF YOUNG CHILDREN.

WE are all agreed to-day as to the value of child-life, for is not this quite commonly described as "the century of the child?" But could we all, if called upon to do so, give sound reasons for this faith we profess to hold? As a matter of fact,

THERE ARE MANY GROUNDS FOR THE OPINION.

It may be the outcome of the anxiety caused by the steadily diminishing birth-rate; or by the appallingly high rate of infant mortality; or the annual toll taken by preventable disease in the early years of life; a series of stern facts brought more and more prominently before the public in the reports of medical and sanitary experts and by a discerning press. Truly they represent a menace to

THE PROGRESSIVE EXISTENCE OF CIVILIZED NATIONS;

because, in a quarter of a century, more or less, there will be a deficiency of sturdy, strenuous, middle-aged burden-bearers in the population and an excess of those whose capacities as Empire-builders are enfeebled by age or undeveloped on account of childish immaturity.

To the sanitarian these unpalatable facts speak, too, of thousands of damaged, debilitated lives, unfit for the stress of modern life, unable to realize their latent powers; for scientific observations, associated with carefully collected statistics, prove conclusively that

THE YOUTHFUL SURVIVORS

of conditions fatal to the more weakly bear obvious traces of their infantile struggle for existence. Many of these lifelong scars may be detected in the form of stunted stature, enfeebled powers of resistance to disease, lowered capacity for work, or in defects of brain, body, sight, and hearing.

Or it may be that our attention has been called to the importance of childhood as

A PERIOD IN LIFE RICH IN POSSIBILITIES,

upon the orderly realization of which depends adult efficiency. It may be that some remarks made in our favourite periodical upon the relative influence of nature and nurture upon the young human being have awakened our interest and aroused in us a deeper respect for this marvellous "clay cottage" in which our spirits are housed.

By whatever means the impression has been made, the fact remains that in most cases

IT IS DEEP AND ENDURING;

hence the growing desire to learn from reliable sources in what consists the intelligent care of child-life.

Societies for the purpose of such study have existed in the Motherland and in the United States for at least twenty-five or thirty years. The Parents' Educational Union, the Mothers' Union, the Child Study Society, the Froebel Society, for instance, have branches all over the United Kingdom; while, of more recent date, the Eugenics Education Society and the National Society for the Welfare of Infancy are emphasizing still other aspects of this comprehensive subject, which embraces every phase of existence and development, physical, mental, and moral; ante- and post-natal childhood and adolescence.

Attention has been called in the last three years to the

WASTAGE OF INFANT-LIFE IN CANADA

by Dr. Helen McMurchy, in her series of stirring reports on "Infant Mortality," printed by order of the Legislative Assembly of Ontario; while a considerable proportion of the pages of the journal which represents the still youthful Canadian Public Health Association are devoted monthly to the intelligent management of children. It is most fitting, therefore, that it should form an item in the study programme of the Women's Institutes.

For, after all, does it not seem a strange thing that hitherto so little time and thought have been given to the influences which contribute to the child's chances of becoming that

NATIONAL ASSET

about which many of us talk so glibly? The delusion dies hard that maternity carries with it the knowledge necessary to the healthful rearing and intelligent training of children. It is true that the realization that an infant's prospects of a healthful and prosperous maturity are promoted or prejudiced by its ancestors is very slowly dawning upon the public mind; but that the parent of to-day is making or marring his descendants in the third or fourth generation is by no means generally recognized.

SOME CENTURIES AGO

a king of France stood watching an ancient man as he laboured without pause, planting date-kernels. "Why," asked the King, "do you sow the seeds of a tree of such slow growth, seeing that the dates will not ripen till a hundred years be passed?" Prompt was the answer to the question: "Am I not now eating the fruit of trees planted by my forefathers, who took thought for those who were to come, and shall not I do likewise?" Is it possible that Dr. Oliver Wendell Holmes had this story in mind when he framed his reply to a lady who inquired

AT WHAT AGE IT WERE WELL TO BEGIN THE EDUCATION OF HER CHILD.

"Madam," said he, "a hundred years before birth."

The ancient sower of date-kernels voiced a deeper truth than even he suspected when he spoke of his responsibility to future generations; the witty reply of "the Poet of the Breakfast Table," forecasted a line of teaching but now receiving tardy attention—namely, that the progenitors of the past transmitted their qualities to many more than their immediate offspring, and that a duty is owed to the unborn, whose lives will be affected for good or ill by our actions in the present and by those of our forefathers in the past.

To study the facts of inherited tendencies; to impress upon the world its responsibility to succeeding generations; to direct the attention of parents to the right of every child to be "well born," is the mission of the Eugenics Education Society, which derives its name from the Greek words "good birth"; for its members perceive that the diseased, the insane, the alcoholic, are incapable of transmitting

THE TORCH OF LIFE

undimmed to their descendants; far less can they hand it on brighter, more brilliant, than they received it.

This part of my subject is too complex and vast to be entered upon in this bulletin; but even a brief reference will illustrate its supreme importance to parents, if only for the light it throws upon a problem often found to be as inconvenient as it is perplexing—namely, the diversity of character and appearance, the variation in capacity to resist infection, the disparity in standard of health, among the members of a family. John is a hopeless truant; Ted is as steady as Old Time; Jane is a veritable angel in the house, while Clara is a firebrand. Mary "catches" everything that comes her way and is always ailing, while Bill enjoys riotous health all his days!

WHY IS THIS?

A common expression when a child shows a marked resemblance to some near relation is to describe him as a chip of the old block.

Now, if a block of marble be subjected to close examination it will be found to consist of countless myriads of particles, welded together into a compact mass. Similarly, a human body is composed of millions of microscopic particles, called cells, from which are built up bone and muscle, nerves, and all its other parts.

At first glance, all blocks of marble and all human bodies seem to resemble each other so closely that it is hard to distinguish between them when we see them for the first time. But a more careful examination will in each case reveal peculiarities possessed by each individual, whether block of marble or human body. No two chips off a block are identical, much less are two human beings ever exactly alike. Infinitely minute as are the "cells" which build up our bodies, nevertheless their characteristics and combinations are influenced in some mysterious way by our ancestors.

If we count the

NUMBER OF THESE ANCESTORS

even to the tenth generation only (two parents, four grandparents, eight great-grandparents, and so on), we shall find to our surprise that more than a thousand forbears have been transmitting more or less of their personality to us in the course of about 250 years. Pursue the calculation for a further period of 250 years and our brains will reel at the formidable number of those who have contributed to our "make-up," moral, mental, or physical. (See Fig. 1.) Thus, each child, while a veritable chip of the old family block, is also a distinct individual, in whom the admixture of family features and characteristics results in a new blend. Sir Francis Galton has foretold that at no distant date a careful record will be kept in every home of the life-history of its inmates, so that among the most cherished possessions of the Empire will be its

GOLDEN BOOK OF THRIVING FAMILIES,

containing the unblemished chronicles of a healthful, moral people, proud of their distinguished ancestry (distinguished by freedom from disease and vice), proud of their capacity to furnish their country with a sane and sound population.

But, though every child has certain definite characteristics inherited from his parents, he has others which are acquired through his own experience in life; that is to say, every individual is the result of two forces—

NATURE AND NURTURE;

and it is extremely difficult to determine which of these two plays the more important part in the production of those characteristics which, when found in combination, we call health. Speaking broadly, we may say that

HEREDITY OR RACE

has much influence in such particulars as the build of a child, the colour of hair and eyes, the type of feature, etc. On the other hand, diseases are not usually inherited, though it must be clearly understood that predisposition to disease IS commonly transmitted from parent to offspring. Take, for example,

THE CASE OF CONSUMPTION.

There are certain families whose children are predisposed to this disease; that is to say, the constitution of the children is such that it provides a better soil for the seeds of consumption to grow in than do the bodies of children not so predisposed.

Again, there are families naturally resistant to certain forms of disease, who, owing to

BAD HOME CONDITIONS OR TO BAD PERSONAL HABITS,

have had their powers of resistance so much weakened that they become susceptible to infection. Evidence has been collected by medical men all over the world which

proves that, no matter how healthy a child may be at birth, good home circumstances are necessary if that health is to be maintained, while the condition of the home depends largely upon the habits of its inmates. A delicate child placed under good conditions of air, light, food, rest, and exercise, and consistently trained in good habits of cleanliness, mastication of food, daily attention to relieving the body of

Fig. 1. To show number of ancestors from whom characteristics are inherited.

- I. Grandparents, 4.
- II. Great-grandparents, 8.
- III. Great-great-grandparents, 16.
- IV. Great-great-great-grandparents, 32.

waste and injurious matters, self-control, and prompt obedience, may attain and maintain a standard of health and power of productive work in maturity never realized by a companion who, from the standpoint of heredity, had infinitely superior chances at birth.

In speaking here of health, will my readers bear in mind that I refer to mental and moral, as well as to physical, health.

Every individual who assumes responsibility for the care of human life, but more especially of

YOUNG HUMAN LIFE,

should be aware that the processes of that life are governed by laws, as are communities and nations. Among these laws are those of—

Heredity, which control the general resemblance of a child to his ancestors:

Variation from a common type, so that each child has qualities peculiar to himself:

Modification by surroundings, by which strong points may be developed or destroyed by the conditions of life:

Adaptability, or the power we all possess to adapt ourselves more or less successfully to our surroundings:

Predisposition, or individual tendency to certain lines of conduct; to contract or to resist certain kinds of disease; or to excel in certain arts, crafts, or professions.

As a knowledge of the existence of these laws has dawned gradually on the world, thanks to the wonderful work and discoveries of scientific observers during the past sixty or seventy years, it can no longer be a matter for surprise that all life becomes more dignified in our eyes, and that

THE RESPONSIBILITIES OF PARENTHOOD

assume a greater importance. We can no longer pretend that a child comes into the world resembling a sheet of white paper, upon which we are free to write the habits and tastes we choose. We are now aware that each infant is a mass of inherited tendencies, the development or repression of which depend upon the surroundings we provide, the food we furnish, the activities we encourage, the sleep and play we permit. To train for the

RIGHT REARING OF CHILDREN

is a duty imposed, not upon parents only, but upon all those who are in any way concerned with their nurture and education. The subject is as vast as it is full of absorbing interest. Several years of my own life have been devoted to gathering information on its many characteristics and phases, and in passing on this information to those whose lives did not allow them to secure it at first hand; to busy parents, to hundreds of teachers, to many of the workers for the world's advancement. One of the first points to claim our attention is

THE DURATION OF CHILDHOOD.

Under the several names of infancy, childhood, and adolescence, this phase of life actually covers the whole period of immaturity in physical development, which, in the human being, extends for twenty-five years after birth (birth itself being a stage in life, not its beginning, as is popularly and conventionally assumed) though it is customary to limit it to a much shorter time.

Two facts of great consequence arise out of this knowledge:—

(1.) The significance to the child's welfare of its antenatal life:

(2.) The recognition that definite training and guidance should be extended to our young folk to a later period than is now usual.

The most critical years of mental growth are those from fifteen to twenty-two or twenty-three; it is during these years that the faculties of moral self-control should develop. If they are left unexercised they fail to do so, for it is exercise which stimulates normal growth. The result is a population prone to following the line of least resistance, content with a lower standard of ideals and attainments than it should be.

Do not assume that I am advocating a policy of

"LEADING STRINGS";

far from that. Young folk must try their wings, must buy their experience. My point is that, by comradeship with their elders, by means of suitable hobbies, recrea-

tions, and occupations, they shall unconsciously be guided to exercise those powers, all ripe for development, which, in the absence of systematic use, never influence conduct.

Remember that the long period of immaturity means power to progress. During immaturity there is plasticity; new habits can be formed, new powers cultivated, increased control of surroundings acquired.

All this, when summed up, represents what we call

EXPERIENCE,

or ability to use the lessons of the past to benefit the future. Consequently we find that where animals take a longer period to attain maturity their lives are longer, so that they can utilize what they learn, as well as enjoy their greater powers of adapting themselves to more varied conditions.

COMPARE A GUINEA-PIG WITH A HORSE.

The limited capacities of a guinea-pig necessitate a very short antenatal life (seven weeks); in seven months it is mature and can reproduce its kind, but its life rarely extends to seven years, neither does it at any period of life or in any generation develop beyond the stage attained by countless generations of its ancestors.

The horse, on the other hand, possesses so much more elaborate a nervous system, so much more capacity for training, that an antenatal period sevenfold as long is essential to "laying down" its outlines and six years is necessary to its development; BUT a horse can be trained in many useful habits and can remain of service for twenty-five or thirty years.

To a far higher degree, mankind

POSSESSES UNREALIZED CAPACITY FOR PROGRESS,

if the quality of the stock is maintained, if the conditions of normal growth be respected, and if due opportunity be offered for the exercise of powers latent in brain and body. It has been well said that, where, from absence of judicious training in youth,

LIBERTY, LUXURY, AND LICENCE CHARACTERIZE MATURITY,

vital bankruptcy is the inevitable result.

Leaving on one side the influences of a child's forefathers, the health of an expectant mother has of late years assumed an importance too long overlooked. It is during these months that her "weak spots" are likely to show; their appearance must on no account be neglected. Errors in diet, exercise, clothing, sleeping, or surroundings must be corrected. Not that there are special laws of health for this period, but, in almost every case,

SPECIAL APPLICATION OF ORDINARY RULES OF LIFE

Is needed. The future of the infant may be threatened by premature birth, by infection with what are known as "racial poisons" (syphilis, alcohol, or lead), or its vitality may be lowered by the defective nutrition of the mother.

The grievous results to the offspring of syphilitic infection eat like a canker at the root of our national life; they could and should be known by all potential parents. The disastrous effects of antenatal poisoning with alcohol have been verified past dispute. They appear as children grow up in the form of epilepsy, warped minds and stunted bodies, mental instability which predisposes to crimes of violence, insanity, and, what is almost worse, feeble mindedness. Chronic alcoholism, too, is a frequent cause of marked malformation in the offspring, although many cases occur in which no history of alcoholism can be traced. Nevertheless,

IN THE OPINION OF THE BEST AUTHORITIES

alcohol in even small quantities has an evil influence upon antenatal life, and should be as religiously eschewed by the nursing as by the expectant mother.

The following simple rules for the expectant mother summarize the opinion of the leading physicians of to-day:—

- (1.) She should go about her ordinary duties as usual, *unless orders to the contrary are given by her doctor*:
- (2.) On no account should she remain inactive or give up exercise in the open air:
- (3.) She should, however, avoid undue excitement and overfatigue, as well as, so far as is possible, mental strain and worry:
- (4.) Her food should be plain, wholesome, and free from any form of alcohol:
- (5.) She should live and sleep in well-ventilated rooms, and spend all the time she can in the open air:
- (6.) Her dress should not be tight or heavy, and her skin should be kept healthy by baths:
- (7.) Special attention should be given to her teeth, for one decayed tooth interferes with nutrition and exposes the body to a process of slow poisoning:
- (8.) No symptom of disorder or of ill-health should be neglected. In justice to the unborn child, medical advice should be sought. Only the expert knows how often "one stitch in time saves nine."

CHARACTERISTICS OF CHILDHOOD.

Most mothers, if asked to describe the characteristics of a healthy child, would most probably and properly reply that these depend upon its age. During infancy the capacity for profound sleep is the most striking characteristic; a year or two

Fig. 2. Showing relative proportions of a child and adult.

later the ceaseless activity of a normal little boy or girl is often a source of actual inconvenience to the busy mother, especially when to this restlessness is shortly added an insatiable curiosity. Little fingers insist upon carrying out all sorts of

investigations; small feet carry their owner into every nook and corner of the home; and meanwhile the little tongue is never still, but persists in putting an endless series of often unanswerable questions.

THIS STAGE OF ACTIVITY

is associated with remarkable facility for imitation, which gradually develops into self-initiated "make-believe" games, wholly absorbing to the player, who will work with perseverance and vigour to attain some desired result. What part do these characteristics play in growth and development? What does each of them contribute to the upbuilding of that most wonderful thing in the world—a normal human being?

THE PERIOD OF INFANCY

is concerned with the unfolding of life; for, at birth, the baby is but a sketch of what it will eventually become. Its very proportions testify to its incompleteness. Look at the enormous head, one-fourth the length of its body (the head of a well-proportioned adult is but one-eighth of his height). Look at the ridiculous little limbs; the arms must become four times their length at birth, and the legs must elongate fivefold before maturity is attained at twenty-five years of age. The shape and proportions of the trunk must pass through many phases and stages before they assume their permanent form. Each internal organ, each system and part of the body, shares in these profound changes, which continue for a full quarter of a century; in the case of the brain, indeed, there is no term set to its possibilities of further development. In the case of the muscular system this usually ceases between forty and fifty years of age.

The healthy infant is a passive, placid creature, whose chief business is to grow (a baby should nearly treble its weight at birth during the first year of postnatal life). At the same time it is adapting itself to its new surroundings and gradually exercising its unknown powers. The ceaseless activity and insatiable curiosity of the little child during its waking hours are necessary to nutrition and growth, equally of mind and body; if unwisely checked, normal development is impossible.

THE CHIEF REQUIREMENTS OF INFANCY AND EARLY CHILDHOOD ARE:

Prolonged periods of quiet sleep, undisturbed by noise, light, movement, or other interruptions:

Food suited to the age, taken at right intervals, with machine-like regularity:

Scrupulous cleanliness of person, clothing, and surroundings:

Pure air, warmth, sunshine, and suited exercise; last, but not least, consistent training in good habits.

To deal adequately with even a portion of these requirements would call for a whole bulletin; space permits of the most cursory details only.

SLEEP

is a state of healthy repose during which energy is recruited, all kinds of physical growth promoted, and the results of fatigue removed. If exposed to noise, bright light, or movement during sleep, the process of repair and the general refreshment of the body are interrupted; the sleeper awakes with feelings of weariness and nervous exhaustion; while, in the case of children, growth is stunted and mental instability is fostered.

A glance at Fig. 3 will show the number of hours which should be absorbed by sleep during early life; it also shows the average number of hours which were the portion of several thousand girls and boys in England when I pursued my investigations seven or eight years ago. It is a matter for thankfulness that the attention attracted by the publication of these results has been one factor in securing improved conditions for many children. It is equally a matter for regret that in this new country, free from many of the economic problems which make life hard on the poorer part of the population in the Old World, the habit of prolonged quiet sleep is

not being systematically formed in the children. Yet the first authorities on nervous diseases and insanity are unanimous in their opinion that it is the soundest insurance against mental instability, so sadly prevalent in modern life.

FIG. 3. AN INQUIRY INTO THE HOURS OF SLEEP OF 9,000 CHILDREN IN ELEMENTARY SCHOOLS.
Years of age.

Average hours of sleep at different ages of 4,521 girls and 3,935 boys from infancy to sixteen. Results of an investigation among Elementary School children in England.

IT IS UNJUSTIFIABLE

- (1.) To carry babies to places of entertainment or to private social gatherings, where lights are bright, air vitiated, and there is much noise; or
- (2.) To transport them constantly in conveyances without springs, such as the modern "go-cart," or in noisy street-cars and trains.

THROUGHOUT LIFE

sleep should be enjoyed in a bed comfortably warm (never be afraid to use hot-water bottles or hot bricks). Cold feet mean growth checked and heavy bed-covers are unwholesome.

The windows of a bedroom should be always open, except in very severe frost, when the occupant is in bed, and the light must always be shaded from the sleeper's eyes; which reminds me to draw attention to

AN UNCONSCIOUSLY UNKIND ACT

on the part of many in charge of young children—namely, laying them flat in perambulator or cradle without shielding their eyes from the bright light, or even from direct sunshine. A moment's experiment with ourselves in a similar position will fill us with self-reproach. By preference such shades should be a pale green; on no account resort to a flapping and bewildering sunbonnet or floppy hat; though, on the other hand, no young child should be taken out with unprotected head. The bones of the skull are very immature during these early years and, in conjunction with the scanty hair natural at this stage of life, afford no adequate protection from the sun.

FOOD IN INFANCY

should offer no difficulty. Nature provides all that a baby needs for the first nine postnatal months. Week by week this supply is adapted in quality and quantity to its growing requirements. Few people are aware of the subtle, marvellous changes in these respects which take place in Nature's own laboratory, the mother's breast. To imitate or replace them by artificial means is absolutely impossible. "The only way in which

TO ADAPT COW'S MILK TO AN INFANT'S NEEDS,"

writes one of the first authorities on the management of babies, "is to pass it through the mother's body." It suffices to say that the death-rate among hand-fed children is from twenty to thirty times greater than among those whose mothers fulfil their maternal duties in this respect; while here, again, must be borne in mind the risk of damaged physique among the children who survive being fed on cow's or other forms of milk, though it may be years before the damage shows.

NO TROUBLE IS TOO GREAT

to enable a mother thus to safeguard her infant during these months of helplessness and dependence. The latest teaching on the intervals between feeds advocates three hours after the first fortnight, from 5 a.m. until 11 p.m., with a six-hours interval at night, which allows the mother necessary repose and rests the digestive organs of the infant.

Never break the habit of absolute regularity. There are many other reasons for crying than hunger, and a teaspoonful of warm boiled water will often soothe a fretting baby, who cannot voice its thirst by any other means.

HAND-FED INFANTS USUALLY SUFFER FROM EXCESS OF FOOD.

Fig. 4 illustrates the exact size of a baby's stomach at birth; most feeding-bottles hold 8 oz., a capacity not attained by the stomach under at least three months; and our sensations must have taught us at some period or other of our lives that to fill the stomach to its utmost capacity is accompanied with feelings of great discomfort! The use of tube feeding-bottles is forbidden by law in France and discouraged in every country.

Fig. 4. Infant's stomach at birth; exact size

A child is weaned about the tenth month, but milk should remain its staple food for the next three years, and should play an important part in its diet until nine or ten years old. For this reason, sugar should not be introduced too early to a child's notice, or it loses its taste for milk, which contains sugar, it is true, but in another form from that served at our tables or manufactured into candles.

DO NOT BE AFRAID

to give crisp bread, toast, or cracker to little folk so soon as they have cut four teeth and can begin to train their jaws to chew. At first, after weaning, much of their food must be soft (the lightly boiled yolk of an egg, potato mashed in gravy, pounded fish or chicken, milk-puddings, etc.); therefore see to it that the necessary exercise of jaw and teeth, the essential training in mastication, are provided by a systematic supply of crisp breadstuffs.

THE HEALTH OF THE MILK-TEETH

is decided by the nutrition of the mother during the antenatal period; the well-being of the permanent teeth depends upon whether or not they are infected by the decay of the first set of teeth, and upon the regular and sufficient exercise of the growing

FIG. 5. DIAGRAM OF TEETH OF CHILD.

(Reproduced from Dental Charts for School Use.)

jaws. A decayed tooth must receive immediate attention from the dentist, otherwise the remaining teeth are infected. Besides which, if one tooth of either set be lost, two other teeth have their work hindered. Look at Fig. 5. The truth of this statement is conclusively proved.

TWO INVOLABLE RULES

must govern the care of children's teeth:—

- (1.) Each meal after weaning must close either with a drink of water; the chewing of a piece of crisp crust, or toast or cracker; or a few teaspoonfuls of orange-juice. After the age of seven or eight a crisp apple or even one or two nuts may replace the other forms of mouth-cleansers:
- (2.) So soon as a child has two teeth side by side the mother must accustom it to washing the teeth with warm water and a simple powder (not paste or fluid) at bed-time, and preferably in the morning also.

NOTE.—Under no circumstances may a child be sent to bed with candy or sweet-cake or biscuit after the washing of its mouth.

While on the subject of a child's diet, it may be well

TO DISCUSS FOUR POINTS

which often present difficulties to mothers. I refer to the character and quantity of a child's drinks; its distaste for fat; its strong desire for snacks between meals; and the too prevalent tendency to constipation.

Do not be afraid to let a child drink freely of wholesome water. A healthy, active child of six or seven will drink nearly three pints in twenty-four hours in warm weather. The body cannot carry on the processes of growth and nutrition if there be a deficiency of water in the tissues; but it can easily get rid of an excess of water through the skin, the kidneys, the bowels, or the lungs.

DO NOT CULTIVATE A HABIT

of drinking just before a meal; but if a child rushes in very thirsty as dinner is being served on a hot day, let it drink freely, or it will be unable to eat and digest the food necessary to its support. It is well to train a child, also, to eat its meat before drinking, and then not to drink again till the close of the meal. No harm will follow reasonable drinking of water between meals. A thirsty child is a potentially naughty, and certainly an inattentive, one.

MILK IS A FOOD, NOT A BEVERAGE;

it becomes solid directly it is swallowed; do not therefore rely upon it as a thirst-quencher. Water flavoured with toast, lemon, or apple, very slightly sweetened, is

Fig. 6.

acceptable to young folk, but set your face sternly against tea or coffee as beverages until towards the age of thirteen or fourteen. Children suffer more from the harmful element in these beverages than we do. Cocoa makes a pleasant flavour in hot water and often induces growing boys and girls to take milk; but, so far as nutriment is concerned, the quantity taken is too small to be of any worth to the body.

ALCOHOL IN ANY FORM IS INADMISSIBLE;

if to be given under doctor's orders, inquire if it may be combined with jelly, which minimizes the risk of a taste being contracted for the flavour as a beverage.

Fat ought to play a considerable part in a child's diet, as will be seen on reference to the chart of relative proportion of nutrients required at different age periods. (Fig. 6.) Unfortunately, this is often distasteful, except in its most expensive forms of cream and butter. Where these are available, cream with stewed fruit at breakfast and dinner and a plentiful supply of bread and butter (except with hot meats) are excellent foods. Where their supply is limited,

FIRST-CLASS SUBSTITUTES

are provided in dripping, finely chopped fresh suet, and lard; these last forms of fat must be served in one of the many disguises offered by steamed or boiled puddings. The mixture can be flavoured with molasses or ginger, combined with sultanas, raisins, or fresh fruit (currants are too indigestible to be included in any child's dietary), eaten with sugar, preserves, jelly, or soup; while, in winter-time, home-made toffee is a wholesome addition to breakfast or lunch for a healthy child, but must never be eaten between meals.

Fresh eggs, too, contain a most digestible form of fat; but fat fish, such as salmon, herring, or mackerel, are not good for young children.

NO FRIED FOOD, PASTRY, OR HOT CAKES

should be given to little folk, neither are nuts (a food very rich in fat) allowable under the age of nine or ten, and then only in small quantities, taken as a part of a meal.

Children crave for fruit but often dislike vegetables. If freely supplied with fruit in a suitable form, the craving for sugar (of which there is a relatively large proportion in fruits) is legitimately gratified. For the first two years of life the juice of an orange is alone permissible; then a little of the pulp of a baked apple may be given, prunes stewed and finely mashed with a fork, or baked banana.

ALL FRUIT SHOULD BE COOKED

before it is given to children under nine; especially bananas, plums and other stone-fruit, from which the skins must also be removed. All fruit containing seeds, such as berries and grapes, must have the seeds removed. In the case of berries this means rubbing through a sieve. It cannot be too forcibly impressed that a child's digestive system is

THE WEAK LINK IN ITS CHAIN OF HEALTH.

The extreme delicacy of the membrane lining the bowels renders it very susceptible to damage by coarse particles (such as are present in coarse oatmeal or whole-meal bread), and by the seeds in fruit, such as strawberries, or by currants or carraways in cakes, or by imperfectly chewed and undigested morsels of nuts. The germs of consumption or of diarrhoea, to mention two common sources of death among our child population, may gain access to the body through the tiny abrasions which are caused by these internal scratches; while, in the absence of such infection, the products of the process of digestion, which should be excreted, are liable to be absorbed into the blood-stream, and bring about a kind of self-poisoning, which shows itself in "bilious attacks," ill-temper, debility, and many other symptoms of depressed health.

THE DESIRE FOR SNACKS

between meals may arise from one of several causes:—

- (a.) It may be from a deficiency of sugar in the diet; if so, a more liberal supply of fruit suitably prepared, with the meals, will soon remove the unwholesome craving. Over and over again it has been proved that the wish for candies (one of the most pernicious of habits) can be checked in this way:
- (b.) It may be from some defect in the digestive process, so that the child is really hungry, although well furnished with food. This is a case for medical advice:
- (c.) It may be, and too often is, merely a bad habit, which must be broken, no matter at what expenditure of patience and perseverance. It takes its rise in infancy, when the mother responds to every wail with food (sheer cruelty instead of kindness), or stuffs a "comforter" into the baby's mouth to keep it quiet.

THE HABIT OF CONTINUAL SUCKING

is thus formed, and the craving for some object constantly in the mouth is established. Apart from the immediate injury to health by the exhaustion of the digestive organs for want of rest, and the damage to the teeth from a too liberal supply of nutriment to the organisms which cause decay, this detrimental habit of candy-sucking and gum-chewing leads on to early cigarette-smoking in boys, and very frequently to the practice of perpetually desiring "nips" of alcohol to stimulate the jaded palate. Now, these constant "nips" are found to be more deteriorating to the individual and his offspring than rare bouts of drunkenness, bad as these are. Therefore,

THE MOTHERS OF CANADA

cannot be too watchful against the acquirement of either habit by the future parents of the country.

THE SUBJECT OF THE INFANT COMFORTER

may here be fitly introduced, for, as Dr. James Cantlie remarks, "It seems of late years to constitute a chief part of a baby's equipment." He describes it as one "of the most deleterious and destructive" agents to health ever invented. "The evil effects of the prolonged use of the 'comforter' are not merely temporary," he writes; "they continue throughout life, causing a permanent deformity of the mouth, and of the air-passages generally, frequently inducing many associated deformities and disfigurements, resulting in conditions difficult to remedy and incompatible with robust health. To begin with, the marked prevalence of

ADENOIDS

and the introduction of the 'comforter' came in together; . . . the roof of the child's mouth is pushed upwards (see Fig. 7), the floor of the nasal cavity is encroached upon, and the passage of the air through the nose is impeded. The child finds breathing by way of the nose difficult, and mouth-breathing with all its attendant evil effects sets in. The natural channel by which the air enters the lungs is through the nose, where the air is moistened and warmed before it reaches the windpipe and lungs. When the air enters directly by the mouth the throat and tonsils are subjected to irritation, and resulting enlargement of the tonsils still further impedes respiration . . . air is inhaled in lessened and insufficient quantity, leading to diminished expansion of the lungs, narrowing or flattening of the chest, and imperfect purification of the blood." Dr. Cantlie proceeds to describe in detail how adenoid growths are brought about, in what ways the jaws become deformed (this affects the tone of the voice and the right position of the teeth), and how the whole process of digestion is rendered feeble and inefficient by reason of the constant irritation caused by the presence of this filthy, heating, unnatural object in the mouth. This is his conclusion: "A 'comforter' causes deficient respiration, a deformed mouth, a miserable chest, a ruined digestion, adenoids, and ear-troubles."

In the face of this expert evidence it is to be hoped that this vile habit may be banished from this Province. It is wholly unnecessary if a baby is well trained and well managed. I have persuaded many mothers to abandon its use, and they tell me that in two or three days they find the habit can be broken; only, let me remind you that to substitute "thumb-sucking" is almost as pernicious and quite as unnecessary.

LEARNING TO EAT FOOD IN THE RIGHT WAY AT THE RIGHT TIMES

is a part of a child's education. An excellent plan with fanciful children is to treat any kind of food they ought to eat, but do not care about, as one much appreciated by their seniors, only allowed as a treat to juniors. Green vegetables, milk-puddings, or other such simple fare become popular by this method. By the way, raw cucumbers, onions, or tomatoes are very undesirable for young children,

Fig. 7.

Sections of nose and mouth.

Normal relation of parts.

Distortion caused by "comforter."

so are radishes and other salads, especially when combined with rich sauces. Their stringy, indigestible character class them with rhubarb as unfit for children under ten or eleven years of age, and then only sparingly. It should be—but, sad to say, is not—unnecessary to state that no child should ever taste pickles or sauces.

WARM FOOD IS BETTER FOR CHILDREN

than cold, because it is in almost all cases more easily digested. If cold food, such as bread and butter, form the principal item in a meal, then provide a hot drink; water, so hot it can only be sipped, is quite good if cocoa or milk are not at hand. It would be waste of time to point out the unsuitability of ice-cream as a food for small people. No one would trouble to believe what is nevertheless a fact. To take ice-cold food at any age imposes a great strain on the body, but adults have much greater capacity to resist such a tax on their powers than is the case with children. The only occasion when iced food is allowable is during a heat-wave, and then, if given to little children, it should stand until the extreme chill has passed off.

"MY CHILDREN TAKE NO HARM"

will be the exclamation of the majority of mothers. Let me draw their attention to a discovery of recent years, which is confirmed by every advance in the sciences of anatomy, physiology, and sanitation—namely, that the result of unwise actions or of prejudicial habits or of ignorant and careless neglect do not show themselves in a high percentage of cases until many months or years after their occurrence.

YOUNG HUMAN NATURE IS SO ADAPTABLE,

so elastic in its response to the conditions under which it lives, that it is only when some severe strain is imposed by accident, illness, overwork, the shock of a sudden bereavement, or the fulfilment of the function of maternity, that the flaw is revealed, the weak spot gives way, or some unsuspected damage leads to a break-down of the vital machinery.

A wise variety of food is beneficial after the first three years of life; *but*, and this is a "*but*" of primary importance, intelligent regard must be had to a child's age and a child's tastes.

Food which is hated is food undigested, and no child can be starved even for a day without risk. When porridge, or meat as well as its fat, or any one kind of fish, or even eggs, are obviously odious, so that the boy or girl will go hungry rather than eat them, do not attempt to force them down. There are quite definite

FOOD IDIOSYNCRACIES

at all ages, and these must be respected. They may be outgrown; if they are, so much the better.

A child's chief meal should be at midday; to eat heartily just before bed-time is not to be recommended; preferably there should be at least an hour's interval. This introduces the subject of

SCHOOL LUNCHES,

for many children have to take their midday meal away from home. To provide and pack a suitable lunch daily for two or three growing boys and girls calls for considerable management and time; it is far more satisfactory when arrangements are made for a good, hot meal at the school, a method most skilfully developed in the United States, even in rural districts; more slowly adopted in Great Britain, and scarcely yet attempted in Canada. The subject calls for the early attention and prompt action of the Women's Institutes.

THE QUANTITY OF FOOD

required by individual children from infancy upwards varies widely; it depends upon size rather than upon age. If the face be set sternly against "between-meal snacks" in any form, unrestricted consumption at meals may usually be permitted, if demands for "more" are satisfied by bread and butter or simple puddings. If these are contemptuously refused, there is no reason to suspect unsatisfied hunger. Finally, meat or fish should not be given more than once a day under ten, and not more than twice a day during school-life. When a boy begins a man's work he needs a man's diet.

THE PREVALENT TENDENCY TO CONSTIPATION

in early life is usually the result of failure to train, in the necessary habit at a sufficiently early age, or of laxity in the superintendence required to see that as a child becomes more independent he does not ignore the call of nature for relief, owing to his absorption in play or other pursuits.

A clever nurse can train an infant to regularity in this respect by the age of six weeks, with the result that the habit becomes so firmly established that purgative medicine is never needed, to the enormous advantage of the individual; *but*, and once again this is an

IMPORTANT "BUT,"

regularity of time at which the bowels are trained to act is not the only element in successful training; the intestines must act strongly and forcibly, so that their contents can be expelled. This brings in the factor of diet, for there is no strength without work, and the bowels must be trained to work equally with other parts of the body. The food must contain sufficient bulk, which is secured after early life by eating suitably cooked cereals, fruit, and vegetables; it must contain enough fat (the addition of more cream to the diet, or of a little olive-oil or a slice of cold bacon, often removes constipation), and plenty of water must be drunk. Hence the well-known remedy of a glass of water on rising and on retiring to bed.

Remember that there must be no interruption to the habitual hour; and children must be trained to respect this physical need, and to rank it even higher than the brushing of their teeth.

As you value your child's health in later life, never resort to drugs, injections, or suppositories until success by diet has been well tried, and then it is far wiser to seek medical advice.

AVERAGE COMPOSITION OF SOME OF THE MORE IMPORTANT FOODS EMPLOYED IN CHILDHOOD

CLEANLINESS OF PERSON

follows very consistently upon this subject of attention to the relief of the body from injurious material, for the establishment of habitual control of the bladder and bowels is at the root of infant hygiene, making as it does for bodily cleanliness, external as well as internal.

It is wise to remind ourselves that warm water and soap are necessary factors in cleanliness of the skin; therefore each child should have a rapid cleansing of the

whole body daily with these agents, followed by a brisk rub with a Turkish towel. A large quantity of water is not necessary. At first the process can be performed as the baby lies on a blanket on its mother's lap before the fire; later on, the child can stand in a shallow pan of warm water, also near a fire in cold weather, and itself assist in the refreshing performance.

Very careful habits of washing the hands before eating or touching food must be early established, and a pride in clean nails must be cultivated. Apart from the unpleasant appearance of dirty hands, modern science demonstrates the lively existence of countless undesirable and infectious germs in the folds of the skin, the creases of the hands, and the crevices of the nails.

On the importance of dental cleanliness enough has been said; and attention to care of the scalp and hair must now surely be universal, though the wise mother of a large family will keep her girls' hair short as a precaution until they are twelve or thirteen years of age.

WHAT IS THE PLACE OF A COLD BATH?

will be the next question. Is it bracing or does it only depress a child? Its effects depend chiefly upon the early training given to the heat-regulating capacity of a baby's brain. A child can be most advantageously trained to accommodate itself to sudden changes of temperature, as well as to intense changes of temperature, and where this training has been given chills and colds become unknown miseries, unless, of course, the child be infected by some one else who is suffering from a cold.

THE TEMPERATURE OF THE FIRST BATH

should be 99° Fahr., and for some days after birth no change should be made; then slightly cooler water may be used at intervals of two days until the baby will enjoy a morning tub in water 25 or 30 degrees below that of his first experience. Such baths must be short, given before a fire, and followed by rapid drying and dressing. Or a douche of gradually cooled water may be given to the baby's spine, day by day, until at three months old he can stand a douche of cold water with the utmost indifference. Where this training has been neglected, few children benefit from a cold bath.

A WORD OF WARNING

is here in place as to the serious strain on children of what are miscalled "hardening methods," such as sending them about in cold weather with bare arms and legs, or exposing unprotected heads to a burning sun, especially when their feet are immersed in cold water at the seaside or on the lake-shore.

The temperature-regulation machinery in the brain is quite overtaxed by its efforts to keep the bare legs warm and the heated head cool; the delicate nervous system is upset, and the results show themselves in what are described as bilious attacks, chills, etc., the true cause of the ailment being utterly unsuspected by those in charge.

CHILDHOOD IS NOT THE PERIOD FOR HARDENING,

in the popular sense of the term, but essentially it is the age for careful and continuous cultivation of good habits, whether these are habits of prompt obedience to parents, of self-control in moments of pain or excitement, or in physical habits of mastication, cleanliness, and ready, though unconscious, response to changes of temperature.

Given fair chances of developing well-grown bodies to our boys and girls, and they will be "hardy" enough in later life.

ONE SECRET OF HEALTH IN CHILDHOOD

is warmth, furnished by food, clothing, and exercise, not by overheated rooms or coddling. Clothing throughout childhood should be light in weight, easy, elastic, suited to the temperature, washable, and distributed evenly over the surface of the body.

A woven woollen combination reaching from neck to ankles, varying in substance according to the season; a woven woollen bodice to which are attached a pair of woollen knickerbockers, woollen stockings supported by suspenders, a knitted jersey coming well down over the hips, completed by a skirt for girls and knickerbockers for boys, is the ideal costume until school-days are over. The boots and shoes should be broad and easy, with low heels; on no account should high heels and pointed toes be allowed; and open-work stockings should also be taboo.

IT MUST BE BORNE IN MIND

that the younger the child, the larger its surface in proportion to its bulk. Indeed, it is usual to estimate a child's surface as three times as great as that of an adult

Fig. 9.

An improperly clothed child. How to interfere with health and check growth.

in proportion to its size. Now, the body loses heat chiefly from its skin, while warmth is more necessary to a child than to a grown person, because growth and nutrition are checked by cold; consequently suitable clothing is of special importance.

SHEER THOUGHTLESSNESS AND IGNORANCE

leave unprotected just those parts of a child's body where loss of heat is most rapid or attended by most serious results. (See Fig. 9.) I refer to the wrists, knees, and ankles, where the large blood-vessels are very near the surface (consequently, if these are left bare and naked, large volumes of blood are perpetually being chilled), and also to the upper part of

THE LUNGS AND THE ABDOMEN.

If the lungs are insufficiently covered, as when a low-cut frock is worn, their most sensitive part is exposed to the risk of chill; while in the case of the abdomen this risk extends to the intestines, which are close to its surface; the processes of nutrition and growth are hampered or checked in each case, while the predisposition to contract disease is increased. A great authority on the subject of clothing asserts that many boys are stunted for life because they are clothed at too early an age in sailor or other fancy costumes, which leave the abdomen insufficiently protected.

In this country, where changes of temperature are

SUDDEN AND VIOLENT,

woollen clothing is imperative for children. Recent researches, carried out with every care, abundantly confirm all former teaching upon the superiority of wool over every other material, especially for wear next the skin. Limits of space forbid a recapitulation of the sound reasons for this statement, but they are convincing and indisputable.

One word of warning must be given on the subject of the

INFLAMMABILITY OF FLANNELETTE,

unless it be subjected to a special treatment before its sale to the public. Hundreds of agonizing deaths annually are the direct result of this high inflammability, entirely preventable deaths.

Flannelette is made of cotton, and plant-fibres are in nearly every case highly inflammable, owing to the large proportion of cellulose they contain, a substance which consists of about 50 per cent. of oxygen.

THE FIBRES OF ANIMAL ORIGIN MERELY SMOULDER;

if set on fire, they do not flare up into a blaze as vegetable fibres do, because they contain but 20 per cent. of oxygen, besides a large proportion of nitrogen, which does not support combustion.

FEW GARMENTS ARE MORE HEALTHFUL AND SUITABLE

than woollen sweaters; they are warm, elastic, and protect lungs, wrist, and abdomen. Long woollen stockings, supplemented in cold weather by gaiters and stout boots, equally efficiently protect the legs.

Please remember, it is not the number of garments worn by a child which protect it from excess of heat or cold, but their suitability in material, colour, form, and texture.

THE PLACE OF PLAY IN CHILDHOOD

is the next subject to engage our attention. Why is it that the infant loves its daily baby play upon its mother's knee; why is it that institution babies flag, in spite of the elaborate arrangement made for their well-being? Because from the earliest days of life

PLAY IS THE GREAT EDUCATOR,

the means by which a child comes in touch with the great unknown world around it; the channel by which it learns the parts of its own body and the capacity it possesses for movement, for sight, for hearing, for touching, tasting, or smelling.

At first, the tiny infant needs a playmate, and should find one in its mother or nurse; whereas, when one of many in a large institution, there is no time for this form of tender play; so the unexercised powers lie dormant or develop very slowly.

AFTER A FEW MONTHS

the small child will play for hours alone, only asking for the sympathetic interest of its mother. All the time it is testing its faculties and powers, making experiments with the things around it, exercising patience and observation, perseverance and endurance, as well as its senses, its lungs, and its muscles. Happy the child with brothers and sisters to imitate, to teach, to share its pleasures with and to console in sorrow.

TOWARDS THE AGE OF SEVEN OR EIGHT

the spirit of competition becomes more or less active, and fosters fresh effort and innumerable forms of muscular exertion. Then the advantage of combination to attain an end dawns on a child's mind, and in company with its friends wonderful feats are performed by imaginary pirates, or Redskins, or shipwrecked mariners, or robbers!

WHAT DOES ALL THIS MEAN?

Why do we advocate plenty of play for our young people? Because, by means of self-initiated play, and through the agency, later on, of group games, in which the one subordinates himself to the many, our young folk are training their bodies, forming their characters, preparing their immature powers for future usefulness; learning the many and great lessons of life, in the way best adapted to their ages and most suited to their capacities.

CHILDREN DO NOT NEED COSTLY TOYS,

but they do need a sufficient space in which to play (hence the urgent need for playgrounds in all cities); they do need sufficient time for free play (for the first eight years of life, play is the child's work); they need companions of their own age, and they need some kindly supervision, to stimulate or to restrain, to regulate or to soothe. A tin box, some string, a few nails and odd bits of lumber, a sand-pit, a hammer, a swing or a see-saw—these are priceless treasures to healthy children and will furnish them with endless amusement.

BEWARE OF THE MODERN TENDENCY

to lead children to depend upon excitement, which often only causes friction and exhaustion, or upon ready-made distractions and not upon his own resources in his play-hours. How seriously abused, for instance, is the moving-picture show, which might constitute a real educational and also pleasurable agent for our children. So powerful is the craze to frequent these shows that it leads children, in some cases, to commit theft in order to gratify it; while there is only too good reason to believe that certain undesirable pictures are directly responsible for an increase in juvenile crime, as well as the cause of a definite form of serious eye-trouble.

A few words on the subject of

EDUCATION IN EARLY LIFE

must bring this bulletin to a close, though it may be that some of my readers would like some guidance as to the age at which work, in the sense of definite occupation for self-support or to assist parents, should begin. This matter does not come within the scope of my subject, for work in the sense of responsible duty cannot be enforced during those early years with which these pages are concerned.

The young human being suffers in numerous directions from premature work, for childhood is but a preparation for the period when capacity for skilled occupation is ripe for development.

THE FORMATION OF GOOD HABITS

from birth onwards is the best preparation for a productive maturity. The entire object of true education, writes one of our finest educators, is to make people not merely do the right thing, but enjoy the right thing. The parents who have studied the phases of child-development, the capacity for imitation and training so strong in a youth, who have systematically and sympathetically trained their family in habits of physical, mental, and moral control, will have prepared a soil upon which the arts, crafts, or sciences necessary to future successful work will grow and flourish to their hearts' content. It cannot be too often repeated that

HABITS ARE THINGS THAT "HAVE US."

See to it, therefore, that some system governs the habits you grow in the young children for whom you are responsible; that they are those which make for health of body, balance of mind, and nobleness of soul.

Train to implicit and prompt obedience, to absolute regularity in the needful response to the requirements of the body, in consideration for others, and a love of service. It may seem

A TRIVIAL THING

to train a baby from birth in regularity of action of bowels and bladder, in long hours of profound sleep, in the power to regulate its temperature rapidly, and, a little later on, in habits of careful mastication, in prompt obedience, in helpful

service of others, in respect for the good, the true, and the beautiful. But mind and body are so closely intertwined, habits are formed at so early an age, that the character and efficiency of a nation hinge upon the methods pursued by its mothers in the early stages of their children's lives.

NO NOBLER WORK

can be conceived than thus to mould the future of a great people. "What the mother is, the children are," said John Burns. "Let us, therefore, glorify, dignify, and purify motherhood by every means in our power." "Nations are gathered out of nurseries," wrote Charles Kingsley. How needful, therefore, are opportunities for training in the responsible profession of motherhood; how important that all women should cultivate in themselves those qualities and virtues which will equip them to be Empire-builders.

"O'er wayward childhood, wouldst thou hold firm rule,
And sun thee in the light of happy faces;
Love, Hope, and Patience, these must be thy graces,
And in thine own heart let them first keep school."

ALICE RAVENHILL,

*Fellow of the Royal Sanitary Institute; Certificated Lecturer
National Health Society, Great Britain and Ireland.
Author of "Practical Hygiene for Use in Schools";
"Elements of Sanitary Law"; "Some Characteristics
and Requirements of Childhood"; "Household Admin-
istration"; "Household Foes," etc.
Late Lecturer on Hygiene, University of London, King's
College for Women.*

BULLETINS AND CIRCULARS AVAILABLE.

Date issued.	No.	Name.
May 21st, 1901	8	Feeding Farm Animals (Dairy Cows).
November, 1908	25	Orchard Cleansing.
July 19th, 1913	26	Practical Poultry-raising. (4th Edition.)
March 17th, 1911 ...	30	Guide to Bee-keeping.
April, 1911	32	Control of Tuberculosis.
February, 1912	33	Fruit-growing Possibilities, Skeena River. (Reprint.)
January, 1912	35	Place and Purpose of Family Life.
November, 1911	36	Preparation of Food.
February, 1912	38	Preparation of Silos.
February 28th, 1913	39	Natural and Artificial Incubation and Brooding.
March, 1912	40	Alfalfa. (3rd Edition.)
March 11th, 1912 ...	41	Labour-saving Devices.
June, 1913	42	Apiculture in British Columbia.
May 7th, 1912	44	Irrigation in British Columbia.
April 29th, 1912	45	Agricultural Statistics, 1911.
December, 1912	46	Food and Diet. (Part I.)
January 15th, 1913 ..	48	Exhibiting Fruit and Vegetables.
September 3rd, 1913	49	Market Poultry. (2nd Edition.)
March 8th, 1913	50	The Art of Right Living.
March 8th, 1913	51	Information for Fruit-growers.
April 15th, 1913	52	Annual Report, Advisory Board of Women's Institutes.
November 18th, 1913	53	Care of Young Children.
November 20th, 1913	55	Care and Marketing of Eggs.
December 13th, 1913	56	Field-crop Competitions, 1913.
February 26th, 1914	57	Boys and Girls' Field-crop Competitions.
AGRICULTURAL DEPARTMENT CIRCULARS.		
December 4th, 1912	2	Results of Field-crop Competition, 1912.
April 29th, 1913	4	Hints on Caring for School Gardens.
December, 1913	5	Field-crop Competitions, 1913-14.
June 12th, 1911	..	How to grow Tobacco from Seed.
CIRCULAR BULLETINS.		
April 29th, 1913	2	Tuberculosis in Poultry. (2nd Edition.)
July 23rd, 1913	3	Construction of Fresh-air Brooders. (2nd Edition.)
October 14th, 1913 ..	4	Management of Turkeys.
December 13th, 1913	5	Clover Dodder.
REPORTS.		
May 9th, 1913	..	Fourteenth Annual Report, Farmers' Institutes, 1912.
September 5th, 1913	..	Fourth Annual Report, Agricultural Fairs Association.
September 22nd, 1913	..	Report of Meeting, British Columbia Entomological Society.
June, 1913	..	British Columbia Dairymen's Report.

VICTORIA, B.C.:

Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.

1914.

THIS BOOK IS DUE ON THE LAST DATE
STAMPED BELOW

AN INITIAL FINE OF 25 CENTS

WILL BE ASSESSED FOR FAILURE TO RETURN
THIS BOOK ON THE DATE DUE. THE PENALTY
WILL INCREASE TO 50 CENTS ON THE FOURTH
DAY AND TO \$1.00 ON THE SEVENTH DAY
OVERDUE.

NOV 28 1942

4 May '53 HD

APR 19 1953 LU

LD 21-100m-7,'40 (6986s)

YD 14176

309887

British Col.

S141

A4

no. 44-53

OCT 14 1916

UNIVERSITY OF CALIFORNIA LIBRARY