VEGETABLE GARDENING.

SAMUEL B. GREEN.

Vegetable Gardening

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Vegetable Gardening

A MANUAL ON THE GROWING OF VEGETABLES
FOR HOME USE AND MARKETING

By

SAMUEL B. GREEN

Late Professor of Horticulture, University of Minnesota, and Author of "Popular Fruit Growing," "Forestry in Minnesota," Principles of American Forestry," "Farm Windbreaks and Shelterbelts," etc.

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PREFACE TO NINTH EDITION

This book was prepared primarily for the School of Agriculture of the University of Minnesota, where it has been used as a textbook since it was first published. It is the result of the development of the system of teaching at this school and is intended for students of the high school grade. In this the ninth edition a few changes have been made to bring it up-to-date in the matter of methods of culture and varieties recommended.

In previous editions I have taken pleasure, as I do now, in acknowledging the assistance which I have received in many ways in preparing the manuscript for the first edition of this book from Prof. Harry Snyder, the late Dr. Otto Lugger, the late Major A. G. Wilcox, and my former assistant, Prof. R. S. Mackintosh, now Professor of Horticulture at Auburn, Alabama. In preparing this edition, I have been helped by Mr. A. R. Kohler, Assistant in Horticulture.

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SAMUEL B. GREEN,

St. Anthony Park, Minn., November 1st, 1909.

PREFACE TO THIRTEENTH EDITION

It has seemed desirable to have this book revised, because some of the plates in the last edition of Vegetable Gardening were dim, and because new machinery, methods of culture, and new varieties of plants are all the time being developed and new remedies are being constantly used for plant diseases. By including these the book is brought entirely up-to-date.

I wish to thank Professor Le Roy Cady, Horticulturist at the Experiment Station, who was trained by my husband and knows his methods, for his services in revising this book in such an acceptable manner.

ALICE H. GREEN
(Mrs. Samuel B. Green).

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VEGETABLE GARDENING

CHAPTER I

THE VEGETABLE GARDEN

VEGETABLE gardening, as usually defined, means the culture of vegetables for table use. Under this head are also included certain plants which botanically are fruits, but are considered horticulturally as vegetables. Among these are watermelons, muskmelons, and tomatoes.

Vegetable growing may be grouped under some four or five divisions, about as follows: Kitchen or Home Gardening, Market Gardening, Trucking, and Greenhouse Culture or Vegetable Forcing.

Market Gardening.—By market gardening we usually mean the growing of vegetables for commercial purposes. For success in market gardening or trucking, a good market, large yields per acre, vegetables of good quality and appearance, well packed, and in the proper season, usually the earlier the better, are essentials for success. This, of course, means good land and good management on the part of the grower. Celery, radishes, onions, etc., are usually regarded as market crops. The vicinity of large cities offers splendid opportunities for market gardening.

Trucking.—Trucking differs from market gardening mainly in that it is carried on on a much larger scale, more as field crops. Cabbage, tomatoes, sweet corn, etc., are crops commonly grown as truck crops. Parts of New York, New Jersey, North Carolina, and Pennsylvania are especially noted as trucking centers.

Vegetable Forcing.—Vegetable forcing is carried on in cold frames, hotbeds, and greenhouses, and has become one of the important branches of vegetable growing, especially in the vicinity of large cities. Lettuce, radishes, tomatoes, and cucumbers are the crops commonly grown.

Kitchen or Home Vegetable Gardening.—By the term "kitchen garden" is meant the large or small tract of land needed to grow vegetables for home use. This should be one of the most profitable parts of the farm, if well taken care of. Large returns may also be obtained from city lot gardens of small area, if a careful succession of crops is followed.

THE HOME GARDEN

If one were to figure the actual value of vegetables that may be raised on a half-acre plot of garden, it would amount to at least $100—ten or fifteen times what any common field crop on the farm will produce on the same area. Besides, there is the satisfaction of having vegetables fresh, and of much better quality than can be bought in town or from a neighbor, unless it be a very near neighbor. Vegetables lose their freshness and character when much time elapses between their harvesting and use. Furthermore, not one-quarter as many will be used if they must be purchased; hence more money is spent for high-priced meats and staple groceries by the man who has no garden. Caring for the garden is a bugbear of many farmers. If properly laid out and managed, the labor required for a half-acre of garden, after it is planted, will not be much more than that for a half-acre of corn.

Location.—The garden should be near the house. It may be that much of the labor of planting and care will fall upon the housewife and children; although this ought not to be unless they desire it. The garden pays well enough to be given proper attention from the men of the house. However, the women will probably prefer to harvest the crop, and perhaps plan the apportionment of the garden space. Either the garden or the chickens should be fenced.

Laying Out the Garden.—If possible, the garden should be close to, or a part of, a cultivated field, and so laid out that it can be cultivated by horse power. It is preferable to run the rows the long way of the garden, and to so plan it that vegetables of similar growth shall be together; for it is easier to cultivate if the rows are the same distance apart. Room for turning must be left at the ends of the rows. The perennials, such as asparagus, rhubarb, and the fruits, should be placed at one side, so as not to interfere with cultivation.

Fig. 1. At work with the garden drill.

Tools.—The kinds of tools to be used will depend on the size of the garden and the inclination of the gardener. If the rows are far enough apart, practically all the work of cultivating may be done by horse power. Many, however, prefer to plant the rows closer together, and to use the hand wheel-hoe, hand seeders, etc. If well prepared, it is really more satisfactory to take care of a small garden with these tools than by horse power. A good seeder and wheel-hoe combined may be purchased for about $12; or the wheel-hoe and attachments may be purchased for between $6 and $7, and the seed-drill for about $8. The separate tools are probably the most satisfactory in the end, even though they cost more. With these tools properly used, very little hand-hoeing will be needed.

Soil.—Any good corn land will grow vegetables and fruits in abundance. Of course, special crops require special conditions. For early crops it is preferable to use rich, sandy, quick-acting soils sloping to the south. This is best also for plants such as vines and tomatoes, which need much warm weather to mature well. Late root crops, cabbage, etc., do best on slightly heavier soils that slope to the north or east, and so are protected from the drying south wind.

Manures.—Well-rotted barnyard manure is the best fertilizer. For late crops it is not necessary that it be thoroughly decayed, as there is time for it to decay before the plants need it. Nitrate of soda and some other commercial fertilizers are occasionally used for special crops, and will probably have to be used more by market gardeners hereafter, on account of the difficulty of getting stable manures.

GARDENING IN GENERAL

Location and Soil.—The land for vegetable gardening should be free from stones and stumps, and easily cultivated. Wet land should be avoided unless it can be drained at a reasonable outlay; if it cannot be drained it is of little worth, as scarcely anything of value can be raised on it. All land for vegetable gardening should be well drained either naturally or artificially, since crops on well drained land suffer least from drought as well as from excess of water. Drained land also gives best and most uniform returns from the manure applied to it. When drainage is lacking in the land, the raising of plants on it is so very much a matter of chance that in the long run it will generally prove unprofitable. Most of the land in cultivation is sufficiently drained naturally, while some land that needs no drainage when used for grass or grain would be greatly improved by being under-drained when it is to be used for some garden crops.

Land having a gently rolling or undulating surface with a southern exposure is the most desirable for general gardening operations, since it receives the full sunlight and allows the most perfect control of the water that falls upon it. When irrigation is practiced, such sloping surface aids greatly in the distribution of the water. For a few crops, such as celery, cabbage, etc., the slope makes very little difference, as flat and even moist (not wet) land is best. There is a great difference in the value of northern and southern slopes for various crops. This difference will frequently amount to one crop a year where the soil is closely tilled. The soil on a southern slope can be worked much earlier in the spring than that having a northern exposure, and often by proper management two crops may be grown in one year in such places, while on a northern slope perhaps only one crop could be raised. Then again, such crops as melons and tomatoes, that require a long season and a warm location to mature, develop fully on a southern slope, while on a northern slope they might not ripen.

IRRIGATION

Irrigation is generally unnecessary in this (Minnesota) section, since we raise fair and even abundant crops nearly every year without its aid, but in almost any season there are periods when if water could be applied to growing crops it would improve them. It will seldom if ever pay to irrigate ordinary farm crops if it is necessary to pump the water used. In order to have irrigation practical for farm crops the water should be carried and distributed on the land by the force of gravity. It may pay to pump water to irrigate some garden crops if the conditions are favorable and the work is done intelligently. In this section irrigation should be used to supplement the rainfall, which should ordinarily be kept from running off the surface of the land by every possible precaution.

Amount of Water Required for Irrigating Different Crops.—Sometimes a very small amount of water applied at the right time will make the difference between a good crop and a total failure, as, for instance, when dry weather comes on just as the strawberry crop is almost ripe, when

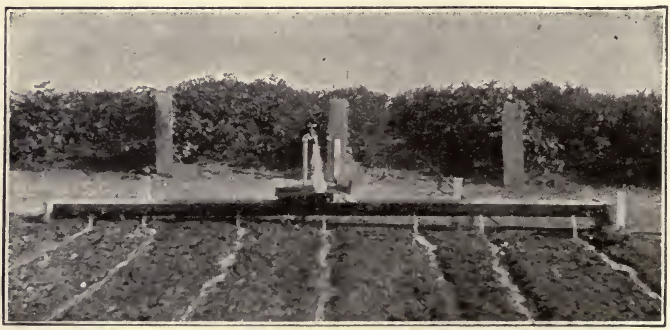

Fig. 2. One method of irrigating crops planted in rows.

it has happened that so small a quantity as 600 barrels of water per acre has been sufficient to ripen the crop. In western Kansas it is estimated that a storage capacity of 5,000 barrels per acre in addition to the ordinary rain supply is needed to mature a crop in dry seasons. In this section a storage capacity of 1,500 barrels per acre would probably be enough to insure against serious injury from drought in any but very exceptionally dry years. Enough water to cover an acre one inch deep is termed an acre inch. About 900 barrels equal one acre inch.

Pumping Water for Irrigation.—Where valuable crops are grown, it will sometimes pay to pump water for them. There are many localities in this section where a large amount of water may be controlled by lifting it less than thirty feet. In such places windmills may be successfully used for pumping the water, providing reservoirs of large capacity can be cheaply made into which water may be pumped the year around to be used as needed. Thresher engines, which are seldom used except in the late summer and fall, may sometimes be used to advantage for pumping water and often at very low cost. Gasoline engines are used in many irrigation works. They are very desirable and in fact necessary on any farm where power can be used. They are useful not only for pumping water but for grinding feed, sawing wood, etc. In putting in a pumping plant the pump should be put as near the water supply as possible.

Reservoirs should be on some elevated point. They are easily made by digging out the earth and puddling the bottom and sides with thick clay, which should be at least one foot in thickness and well packed when wet. A good way to pack it is to drive horses over it. When clay cannot be obtained the bottom may be made tight with a thin coating of coal tar and sand, but clay is preferable, and what is known as blue clay is generally best. Cement is liable to crack badly from frost and is not adapted to this purpose. Made in this way, reservoirs are very cheap and are easily repaired. It is important to have them large where the supply of water is limited; where the supply is large, the reservoir may be much smaller. Wooden tanks are easily and cheaply constructed for holding water.

Application of Water—Sloping land is necessary for most successful irrigation, if the water is to be applied by the force of gravity. It is difficult to apply water to the surface of level land. The slope should be sufficient to permit the water to flow rapidly over the surface and yet not enough to cause it to wash. For irrigation purposes the rows should not be over 300 feet long. The best results are generally obtained from soils having considerable sand in their composition. Drifting sands may often be made to produce good crops by irrigating and manuring, and lands having some sand in their composition are much better adapted to irrigation than clay soils, since the latter often bake badly or become sticky so that they cannot be cultivated immediately after applying water.

Rules for Applying Water to Land.—Water should not be applied unless the crop is suffering for it, but the soil should be cultivated thoroughly and frequently, and thus waste by evaporation may be saved.

Cultivate at once after irrigating, if the land will permit of it, so that the soil will not bake.

Do not apply more than enough water to moisten the land well, and avoid getting it water-soaked.

Do not think that irrigation will take the place of cultivation, for it will not, since without cultivation irrigation is seldom successful.

Water for irrigating purposes should be somewhat warm when applied. Cold springs do not afford a satisfactory supply for some crops unless first pumped into a reservoir. A temperature of 60 degrees is desirable, though not always necessary for the best results.

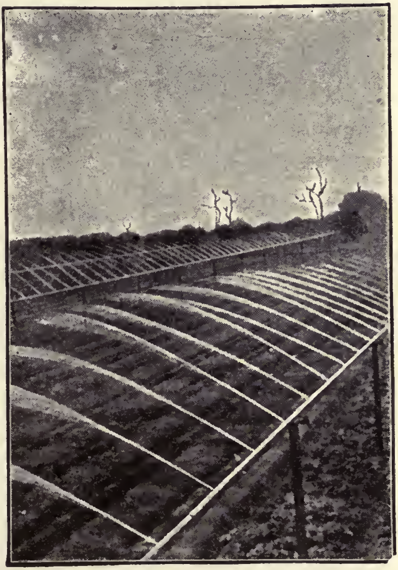

Fig. 3. The Skinner system of irrigation.

Aim to wet the roots of the plants and avoid getting water on the leaves.

Wooden troughs afford the cheapest conduits for water and should be used whenever practicable. Iron pipe is expensive and much more difficult to manage than wooden troughs.

Applying Water with Hose.—In a small garden, lawn hose is a fairly successful means of applying water. On a larger scale it is too cumbersome and expensive a method. It requires constant attention and too much perishable equipment, besides the water cannot be evenly applied. About three acres can be gone over in a day by using a large hose and with a water pressure of one hundred gallons a minute.

Subirrigation is a term that refers to the application of water to the roots of plants by means of underground channels, such as tile or other drains. It works best in sandy soils. In clayey soil the water runs too slowly through the sides of the tiles. Land tiles make as good channels as any for this purpose. They should be buried a few inches below or by the side of the plants to be watered, being laid level with open joints. Some experiments seem to show that it is a very wasteful way of using water, while others have shown this system to be economical. As practiced for watering plants in greenhouse benches, especially for lettuce, it has given excellent results.

Objections to the system are that it is too expensive to supply tile and take them up and reset each year, unless they are set deep below the surface. It will not work well in all kinds of soil. On the other hand, there is less waste of water and less baking of the soil when this system is used.

Overhead or Skinner System.—The Skinner system of watering first came into use about 1904, and this system, or modifications of it, has been of great value to gardeners and florists generally. It is used quite extensively throughout the market gardening districts of the East and to some extent in the West, and has proven of immense value to some garden crops and also to greenhouse vegetables.

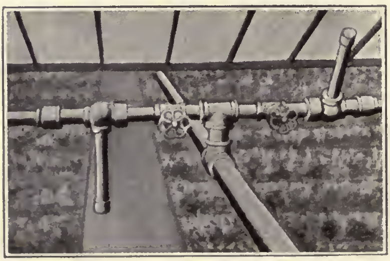

Fig. 4. The Skinner union.

The advantages of the Skinner system over other systems are:—

1. Water is applied uniformly and in a fine spray; thus the ground is not crusted or the plants injured.

2. Very little labor is required to operate the system.

3. Insecticides, fungicides, and fertilizers may be applied by means of this system.

4. It does not interfere with plant growth, because the water falls as a fine mist or spray over the plants.

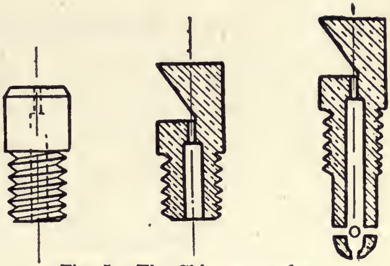

Fig. 5. The Skinner nozzles.

The cost of installing the system varies from $90 to $150 per acre, and is as permanent as the piping used. Water may be used from a reservoir or pumped directly into the system. The greater the pressure, the finer is the spray. The water is distributed by means of a galvanized pipe fitted at intervals of three or four feet with special nozzles; these and the machine for setting them are patented. See Fig. 3. The lines of pipe are set from fifty to sixty feet apart; and when the pipe is supported as in the illustration, the posts are about twenty feet apart. The size of the pipe will of course vary with the distance and number of nozzles on it. Fig. 5 shows the nozzles used; Fig. 4, the union for the Skinner system of irrigation.

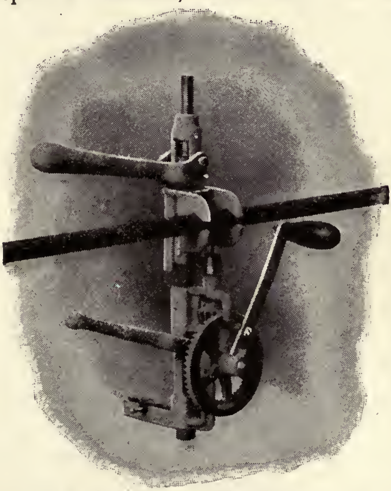

Fig. 6. Machine for securing accuracy in alignment of nozzles in the Skinner system.

ROTATION OF CROPS

By rotation is meant the special succession of crops growing upon the land for a series of years. This is very desirable even on land in the highest state of cultivation, but it is very difficult to lay down exact rules to be followed.

Reasons for Rotating Crops.—We rotate crops for at least six reasons: (1) To avoid insect enemies, as in the case of onions and turnips, which are often liable to serious insect injuries when grown more than one year on the same land. Turnips are especially liable to injury from insects when grown in the same place successively.

(2) To avoid injuries from fungous diseases, i. e., in case of potato and beet scab, onion and melon rust, corn smut, etc.

(3) To increase the amount of humus in the soil, and for this purpose we may seed down the land to grass or clover.

(4) To deepen the soil and add nitrogen to it as well as humus, as when clover is grown on the land.

(5) To get rid of weed seeds in the soil.

(6) To use the plant food in the land to best advantage, since crops vary very much in the amount of the different elements which enter into their composition. Leguminous crops like clover, peas, beans, etc., improve the land on which they grow, while most other crops exhaust the soil. Some plants excel others in their power to search for plant food, or to take plant food from the soil. Some plants feed near the surface largely, while others take their food mostly from a lower level. Root crops should not follow root crops, nor should vines follow vines for many years in succession on the same land.

REVIEW QUESTIONS

1. What location and soil are best for early crops?
2. What location and soil are best for late crops?
3. Under what conditions will it pay to irrigate?
4. When should the land be mulched?
5. What is meant by cultivation?
6. What is humus and how does it affect the soil?
7. What is an acre inch of water and how many barrels does it contain?
8. When will it pay to pump water for irrigation?
9. How may a good, small, cheap reservoir be made?
10. What kind of land is best adapted to irrigation?
11. Give six rules for applying water to land.
12. What is meant by subirrigation?
13. What is meant by rotation of crops?
14. Give six reasons for rotating crops.
15. What crops improve the land on which they grow and why?
16. How does the Skinner system differ from other methods of irrigation?

CHAPTER II

MANURES

Classes.—We might group manures under three heads as follows: Stable or Barnyard Manure; Green Manure, or manure furnished by cover crops; and Commercial Fertilizers, such as nitrate of soda, and tankage.

Stable manure is best for general garden purposes on all soils, since it not only returns the food elements, but also supplies humus. A continued application of commercial fertilizers for several years, without adding to the organic matter, is apt to injure the soil so that the fertilizer is not effective. When this happens, resort must be had to either barnyard manures or cover crops plowed under or both.

Most Valuable Elements in Manures.—While there are twelve or more elements that enter into the composition of cultivated plants, yet only nitrogen, phosphorus, and potash are the essential elements usually not abundant in agricultural soils. Calcium, magnesium, sulphur, and iron are the other essential elements to plant growth, and these are generally abundant in soils. Barnyard manure is a complete fertilizer; nitrogen, phosphorus, and potassium are the valued constituents of commercial fertilizers. Nitrogen is commonly valued at fifteen cents a pound, and phosphorus and potash each five cents a pound.

Humus.—The amount of humus in a soil is of first importance in determining its producing power. Humus is decaying and decayed organic matter. It is the decaying humus that gives life to the soil. It is the seat of bacterial action that results in the production of plant food. By far the most important plant food element thus made into an available form for plants is nitrogen.

Besides being a great storehouse of plant food, humus improves the tilth of soils by making heavy soils more friable and light soils less open, and also increases the water-holding capacity.

Stable manure contains a large amount of humus-forming materials, which undoubtedly add very much to its value, and it is probably on this account that it often gives better returns than commercial fertilizers containing the same quantities of what are termed the essential elements.

The action of manures in the soil can be, and generally is, both direct and indirect. Manures act directly when they contain available plant food or when by their decay they yield it to the plant; they act indirectly when they cause chemical action that decomposes soil particles and sets free mineral plant food from the soil itself. Almost all manures act in this indirect way to some extent. A moderate application of stable manure, by its decomposition (which is chemical action) in the soil, has been known to increase the temperature of the soil by three degrees. Lime in itself is a plant food and is largely used by some crops. Most soils, however, contain it in great abundance, yet if quicklime be added to a soil already rich in common limestone it generally serves to increase growth. This is not due to the plant taking up more lime, but rather to the fact that the quicklime starts chemical action in the soil by which some of the locked-up stores of plant food, especially potassium, are made available. The same may be said of unleached wood ashes, which, however, contain potash in addition to lime. Common salt also acts to some extent as a fertilizer, but it is of no value as a plant food.

Ground limestone may be used to supply lime. This has the advantage of not destroying humus, as is the case with quicklime. The lime is not, however, given up as quickly to the plant, but gradually becomes available.

COMPOSITION OF VEGETABLES AND MANURES

In the following tables are shown the amounts of fertilizing elements contained in vegetables and in the various farm manures and commercial fertilizers. These figures are from eastern United States and European sources. The climatic conditions in these places are quite different from those in many sections of the Western states, where the actual amount of ash ingredients in plants, especially in dry years, may greatly exceed the amounts here given. The relation or these tables to one another is worthy of special study, since they show what the plants need and what the fertilizing materials supply.

TABLE I.—COMPOSITION OF VEGETABLES. ‡

	Water	Ash	Nitrogen	Phosphoric acid	Potash
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Artichokes	81.50	0.99	0.36	0.17	0.48
Asparagus stems	93.96	0.67	0.29	0.08	0.29
Beans, lima	68.46	1.69	....	....	....
Beans, string	87.23	0.76	....	....	....
Beets, red	88.47	1.04	0.24	*0.09	*0.44
Cabbages	90.52	1.40	0.38	*0.11	*0.43
Carrots	88.59	1.02	0.16	0.09	0.51
Cauliflower	90.82	0.81	0.13	0.16	0.36
Chorogi, tubers	78.90	1.09	1.92	0.19	0.64
Chorogi, whole plant	78.33	1.02	....	....	....
Cucumbers	95.99	0.46	0.16	0.12	0.24
Eggplant	92.93	0.50	....	....	....
Horseradish, root	76.68	1.87	0.36	0.07	1.16
Kohlrabi	91.08	1.27	0.48	0.27	0.43
Lettuce, leaves	86.28	1.71	....	....	......
Lettuce, stems	88.46	1.18	....	....	....
Lettuce, whole plant	93.68	1.61	0.23	*0.07	*0.37
Muskmelons, interior juice	92.61	1.01	....	....	....
Muskmelons, pulp	76.44	1.49	....	....	....
Muskmelons, pulp juice	90.53	0.56	....	....	....
Muskmelons, rind	91.15	0.68	....	....	....
Mustard, white	84.19	2.25	....	....	....
Okra	87.41	0.74	....	....	....
Onions	87.55	0.57	0.14	0.04	0.10
Parsnips	80.34	1.03	0.22	0.19	0.62
Peas, Canada field	12.48	2.36	....	....	....

TABLE I.—COMPOSITION OF VEGETABLES.‡—Continued.

	Water	Ash	Nitrogen	Phosphoric acid	Potash
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Peas, garden	12.62	3.11	3.58	0.84	1.01
Peas, green	79.93	0.78	....	....	....
Peas small (*Lathyrus sativus*), whole plant	85.80	5.94	2.50	0.59	1.99
Pumpkins, flesh	93.39	0.67	....	....	....
Pumpkins rind	86.23	1.36	....	....	....
Pumpkins, seeds and stringy matter	76.86	1.51	....	....	....
Pumpkins, whole fruit	92.27	0.63	*0.11	*0.16	*0.09
Rhubarb, roots	74.35	2.28	0.55	0.06	0.53
Rhubarb, stems	92.67	0.94	....	....	....
Rhubarb, stems and leaves	91.67	1.72	0.13	0.02	0.36
Rutabagas	88.61	1.15	0.19	0.12	0.49
Spinach	92.42	1.94	0.49	0.16	0.27
Squashes, flesh	88.09	1.72	....	....	....
Squashes, rind	82.00	1.21	....	....	....
Squashes, seeds and stringy matter	74.03	1.39	....	....	....
Squashes, whole fruit	94.88	0.41	....	....	....
Sweet corn, cobs	80.10	0.59	0.21	0.05	0.22
Sweet corn, husks	86.19	0.56	0.18	0.07	0.22
Sweet corn, kernels	82.14	0.56	0.46	0.07	0.24
Sweet corn, stalks	80.86	1.25	0.28	0.14	0.41
Sweet potatoes, tubers	71.26	1.00	*0.24	*0.08	*0.37
Sweet potatoes, vines	41.55	5.79	....	....	....
Tomatoes, fruit†	93.64	0.47	0.16	0.05	0.27
Tomatoes, roots	73.31	11.72	0.24	0.06	0.29
Tomatoes, vines	83.61	3.00	0.32	0.07	0.50
Turnips	90.46	0.80	0.18	0.10	0.39
Watermelons, juice	93.05	0.20	....	....	....
Watermelons, pulp	91.87	0.33	....	....	....
Watermelons, rind	89.97	1.24	....	....	....
Watermelons, seeds	48.37	1.34	....	....	....

*Wolff. †Sugar in fruit, 3.05 per cent.; acid (malic), 0.46 per cent.
‡Compiled by Office of Experiment Stations.

TABLE II.—COMPOSITION OF FARM MANURES.

	Moisture	Nitrogen	Potash	Phosphoric acid	Lime
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Cattle excrement (solid, fresh)	....	0.29	0.10	0.17	....
Cattle urine (fresh)	....	0.58	0.49	....	....
Hen manure (fresh)	60.00	1.10	0.56	0.85	....
Horse excrement (solid)	....	0.44	0.35	0.17	....
Horse urine (fresh)	....	1.55	1.50	....	....
Human excrement (solid)	77.20	1.00	0.25	1.09	....
Human urine	95.90	0.60	0.20	0.17	....
Pigeon manure (dry)	10.00	3.20	1.00	1.90	2.10
Poudrette (night soil)	50.00	0.80	0.30	1.40	0.80
Sheep excrement (solid, fresh)	....	0.55	0.15	0.31	....
Sheep urine (fresh)	....	1.95	2.26	0.01	....
Stable manure (mixed)	73.27	0.50	0.60	0.30	....
Swine excrement (solid, fresh)	....	0.60	0.13	0.41	....
Swine urine (fresh)	....	0.43	0.83	0.07	....
Barnyard manure (average)	68.87	0.49	0.43	0.32	....

TABLE III.—COMPOSITION OF COMMERCIAL FERTILIZING MATERIALS.

	Moisture	Nitrogen	Potash	Phosphoric acid			Lime
				Soluble	Reverted	Total	
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Acid phosphate	......	......	......	......	......	......	......
Apatite	......	......	......	......	......	36.08	......
Ashes (anthracite coal)	......	......	0.10	......	......	0.10	......
Ashes (bituminous coal)	......	......	0.40	......	......	0.40	......
Ashes (lime kiln)	15.45	......	1.20	......	......	1.14	48.50
Ashes (wood, leached)	30.22	......	1.27	......	......	1.51	28.08
Ashes, (wood, unleached)	12.50	......	5.25	......	......	1.70	34.00
Basic slag	......	......	......	......	......	15.00	35 to 40
Bat guano	40.09	8.20	1.31	2.37	1.24	3.80	......
Bone ash	7.00	......	......	......	......	35.89	44.89
Bone black	4.60	......	......	......	......	28.28	......
Bone black (dissolved)	......	......	......	15.40	1.30	17.00	......
Bonemeal	7.50	4.05	......	0.40	7.60	23.25	......
Bone meal (dissolved)	......	2.60	......	13.53		17.60	......
Bone meal (free from fat)	......	6.20	......	......	......	20.10	......
Bone meal (from glue factory)	......	1.70	......	......	......	29.90	......
Carribean guano	7.31	......	......	......	......	26.77	39.95
Castor pomace	9.50	5.50	1.10	......	......	1.75	......
Cotton-hull ashes	7.80	......	22.75	1.25	6.50	8.85	9.60
Cotton-seed meal (decorticated)	7.75	7.10	1.80	......	......	3.10	......
Cotton-seed meal (undecorticated)	......	4.30	1.50	......	......	3.10	......
Cuba guano	24.27	1.67	......	......	......	13.35	......
Dried blood	12.50	10.52	......	......	......	1.91	......
Dried fish	12.75	7.25	......	0.55	2.60	8.25	......
Gas lime	22.28	......	......	......	......	......	43.66
Horn and hoof waste	10.17	13.25	......	......	......	1.83	......
Kainit	3.20	......	13.54	......	......	......	1.15
Krugite	4.82	......	8.42	......	......	......	12.45
Meat scrap	12.09	10.44	......	......	......	2.07	......
Mono Island guano	13.32	0.76	......	......	7.55	21.88	37.49
Muck	50.00	1.10	0.15	......	......	0.10	......
Mud (salt)	60.00	0.40	0.35	......	......	0.10	0.90
Muriate of potash	2.00	......	51.48	......	......	......	......
Navassa phosphate	7.60	......	......	......	......	34.27	37.45
Nitrate of potash	1.93	13.09	45.19	......	......	......	......
Nitrate of soda	1.40	15.70	......	......	......	......	......
Oleomargarine refuse	8.54	12.12	......	......	......	0.88	......
Peat	61.50	0.85	0.18	......	......	0.08	......
Peruvian guano	14.81	7.35	2.65	3.20	4.10	15.30	......
Phosphates from Florida†	2.25	......	......	......	......	24.50	28.50
Plaster (pure)‡	......	......	......	......	......	......	20.93
Sewage sludge (precipitated)	88.49	0.05	0.05	......	......	0.10	1.58
Soot	5.54	......	1.83	......	......	......	......
Spent tanbark ashes	3.61	......	2.04	......	......	1.61	33.46

TABLE III.—Composition of Commercial Fertilizing Materials —Continued.

	Moisture	Nitrogen	Potash	Phosphoric acid			Lime
				Soluble	Reverted	Total	
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Sumac waste.........	63.06	1.19	3.25	....	....	....	1.14
Sulphate of ammonia.	1.00	20.50	....	....	....	....	....
Sulphate of potash and magnesia......	4.75	....	25.50	....	....	....	5.57
Sulphate of potash (high grade).......	2.54	....	23.40	....	....	....	....
Tankage............	10.00	6.70	....	0.30	5.10	11.80	....
Tobacco stalks.......	6.18	3.71	5.02	....	....	0.65	2.22
Tobacco stems.......	10.00	2.35	8.20	....	....	0.70	4.20
Wool washings.......	....	....	3.92	....	....	....	....
Wool waste..........	15.80	6.50	*1.20	....	....	0.35	0.11

*Sometimes as high as 5 per cent.
†Raw rock phosphate has from 18 to 30 per cent of phosphoric acid.
‡Nova Scotia plaster contains 94 per cent pure gypsum and 4 per cent carbonate of lime; Onondaga and Cayuga, 65-75 per cent gypsum and 18-28 per cent carbonate of lime.

Animal Manures.—Manure from animals of the same class may vary greatly in quality according to the kind of food and the condition and age of the animals. Fat animals fed on food rich in nitrogen (grains) produce the best manures. Young, growing animals that are fed on poor food, such as straw, swale hay, etc., produce very inferior manure. The manure from young, growing animals or from milking cows is much inferior to that from fat steers, since, in the case of the young animals, a large amount of nitrogen and phosphoric acid is required to build up the animal body. In the case of the milking cow a large amount of nitrogen is required for the production of the casein of the milk, while very little of the nitrogen in the food is retained in the body of the fattening animal. The fats, oils, and starchy materials that animals use largely are of no value as manures. The nitrogen, potash, and phosphorus are thrown off by the fat animal in the waste products. Manures rich in nitrogen ferment most rapidly, other things being equal. The urine is generally rich in nitrogen, and since all it contains is soluble it is of more value than the solid excrements of animals, and special effort should be made to save it.

The heating of manures and other organic material is due to the presence of various kinds of bacteria that break down the composition of the materials in which they grow and produce chemical changes that result in the formation of heat. Fire fanged is a term applied to manure which has heated, by the action of fungi, to a very high temperature without sufficient moisture. It is generally white in color and has lost much of its texture, and parts of it may appear to have been burned to ashes. When in this condition manure is regarded as of little value, for it has probably lost much if not all of its nitrogen, and all the ferments which it contained are destroyed. And it is probable that the bacteria and other ferments which are added to soils by manure are often of much importance to them.

Horse manure is loose and light, and ferments very quickly. On this account it is especially valuable for early spring crops, as it makes the soil loose, thus permitting the air to penetrate it easily, while by its rapid fermentation it warms the land. It is valuable to mix with cow and swine manure, since it hastens the fermentation of these cold manures. On account of its heating qualities it is used to warm hotbeds.

Near the large cities gardeners pay from 25 cents to $2 per load of from two to four tons for horse manure, in some cases buying out the product of a barn for a year or series of years at a fixed price. The difficulty of obtaining horse manure is compelling some gardeners to use glass structures or to take up some other line of work.

Hen manure is one of the richest farm manures, for the reason that poultry live on highly concentrated food and that the liquid and solid excrements are voided together. It heats quite readily and violently and should be used very sparingly and with caution, since if put in contact with the roots or stems of plants it is very liable to burn them. It should be handled with great care and be kept dry. If wet, it ferments and parts with its nitrogen in the form of ammonia gas, which is readily perceptible to the nose. For the same reason it should not be mixed with lime or wood ashes unless used at once. It acts very quickly, and on this account is valuable for early crops or to apply during the growth of a crop when the available manure in the land appears to have been exhausted. It may be composted with dry peat or muck, when it is more safely applied than if clear, and there is less danger of loss from heating. Twenty to thirty bushels of hen manure is generally sufficient for one acre when used with stable manure.

Cattle and swine manures are rather slow in action, consequently they are not as desirable for early crops as horse manure, while they are excellent for late crops. For this latter purpose they are often better than horse manure. If they are mixed with horse manure they ferment very rapidly.

Sheep manure is a very concentrated manure and heats rapidly. It is one of the best farm manures.

Mixing Manures.—It may often be a good plan to mix the different kinds of animal manures for general application, as in this way all seem to be improved. Hen manure is an exception and, as a rule, should be applied separately. Lime, wood ashes, or other material of an alkaline nature should never be mixed with stable manure of any kind unless a considerable amount of loam, peat, or other material is added to absorb the ammonia, which is always liberated when nitrogenous and alkaline substances are thus mixed. It is a good plan to mix ground bone, tankage, and other slow-acting fertilizers with heating stable manure, as by so doing the plant food they contain is made more available and the stable manure is greatly improved in quality.

The Manure Pile.—If early garden crops are to be grown, it is necessary to have fine, well-rotted manure, and this makes the manure pile necessary. It should be placed so that as little waste as possible will occur from leaching by rains. When a manure pile is to remain in one place for a considerable time it should be made upon a bed of leaves, peat, loam, rotted sods or other absorbent, about one foot in thickness, which will catch and retain any fertilizing material that may leach through the pile.

Fermentation may be controlled by keeping the pile compact and moist. If practicable, the pile should be made where it will be protected from the sun and from drying winds. The height of the pile should depend somewhat on the kind of manure and the season of the year when it is made. Manures that heat readily should be piled about six feet deep. When the pile is quite warm the manure should be turned over. This operation should be performed very thoroughly as often as the pile gets hot. All the lumps should be broken up and the whole pile turned to the bottom of the bed on which it is placed. The absorbents of the bed should be mixed evenly throughout the pile and the cold manure from the outside put on the inside of the pile so that it may decompose the more evenly.

If the pile appears dry on the inside, apply water, or, what is better, the urine from the stable should be added to assist fermentation, as this cannot take place satisfactorily in dry manure, and the lack of water may result in serious loss. The number of times a manure pile should be turned over will depend on the crop to which it is to be applied and the kind and condition of the manure. This is a matter which must be left to the good judgment of the individual manager, but some of the factors bearing on this will be discussed further on.

The compost heap can be made a prolific source of homemade manure. Every farm and garden should have one of sufficiently large proportion to take care of all refuse organic material about the place. It should be made about as follows: Select a place handy to get at but where there is no standing water, and put down first a bed one foot deep of old sods or muck, and on this pile all the refuse material as it collects in various places. This material may consist of old straw, leaves, and occasional load of heating manure, rotten vegetables, etc. This should be turned over occasionally, by hand if necessary; but the best plan is to have the compost heap in a hog yard and to it haul manure as it collects near the stables. If manure is piled upon a good bed of rotten sod it will not lose much by leaching, nor will it lose anything by heating if a sufficient number of hogs have the run of it to keep it well worked up, taking the place of hand turning.

Green Manures.—Where plenty of land is available, the gardener may often use some green crop, as rye, cowpeas, wheat, or some of the clovers, as a cover or a green-manuring crop, plowing it under when weather and soil conditions are best. Such crops not only utilize and save for future use plant food that continues to be elaborated in the soil and which might suffer loss from leaching or otherwise, but also is an excellent means of increasing the store of life-giving humus. Legume crops are especially valuble for this purpose. In some districts a green crop is planted as soon as potatoes are taken off and is plowed under as soon as large enough.

Commercial Fertilizers.—By commercial fertilizers is meant those manures that are commonly sold by the trade. When of a high price they are generally of a guaranteed composition, and they should be bought at a valuation based on the amount of nitrogen, potash, and phosphoric acid which they contain in an available condition for plants. The more available the form in which these materials exist in the fertilizer, the more valuable it is generally considered. Most states require a guaranteed analysis to accompany the packages in which the fertilizers are sold, and exercise some supervision over the business. Among the most common commercial fertilizers are the following:—

Tankage.—Tankage is a refuse product from slaughtering establishments, which after being deprived of its fat is brought to dryness and ground. It is very rich in nitrogen and phosphoric acid, but contains very little potash. Most of the nitrogen and phosphoric acid that it contains is immediately available to the roots of plants. It is probably the cheapest source of nitrogen and phosphoric acid to be found in the Western states. It varies considerably in composition, and this may sometimes be accounted for by the fact that in some establishments the blood is separated from the other offal, thus reducing the percentage of nitrogen in the tankage.

Tankage is rather a slow-acting fertilizer. It may safely be used in quantities of less than 1000 pounds per acre if applied broadcast and worked into the soil. Four hundred pounds per acre is generally considered a good application. It may safely be used in these quantities around growing plants of cabbage, corn, lettuce, etc., provided it is spread out evenly and does not come in contact with the roots of the plants.

Ground blood is very rich in nitrogen and is quite difficult to dry thoroughly. If it is at all moist it is likely to heat badly. It is a quick-acting fertilizer, and is seldom used without being mixed with other materials.

Ground bone is rich in phosphoric acid; but fresh bones are better for this purpose than dry bones, since in addition to phosphoric acid they have quite a large percentage of nitrogen, which is very small in amount in bones that are old and dry. It is always best to grind fine the bones that are to be used on the land, and in many cases to then mix them with fermenting stable manure. Ground bone is said to be a lasting fertilizer because its effect can be seen for several years. If bones are burned the nitrogen is wasted. If fresh bones are mixed with unleached wood ashes they will be made soft so as to be easily broken up. It is generally applied in much the same way and for the same purposes as tankage.

Nitrate of soda, called also Chili saltpeter, is imported from Chili. It looks like common salt, and contains about 16 per cent of nitrogen that is perfectly soluble and in form most available for the plant. On this account only very small quantities should be applied at one time, because if not taken up by the plant it may be washed deep into the soil out of reach of the roots. It is especially desirable for early leaf crops such as early spinach, cabbage, and lettuce, and to apply when a crop comes to a standstill.

Nitrate of soda acts with wonderful quickness— almost like magic. It may be applied several times to the growing crop at intervals of two weeks, using from 75 to 100 pounds per acre at each application. It may be sown near the hills if applied to cabbage, but for spinach or similar crops it should be sown broadcast when the plants are perfectly dry or during a hard rain. If it sticks to the leaves it is likely to burn them. If sown during a hard rain it is quickly dissolved and washed to the roots of the plants without injury to the leaves. It is expensive and should never be used when a cheaper supply of nitrogenous manure will do just as well. It may occasionally be used to good

Fig. 7. Spinach plants grown on land rich in rotten stable manure. The larger plant received, in addition to the stable manure, nitrate of soda at the rate of 150 pounds per acre.

advantage in water at the rate of one-half ounce of nitrate of soda to one gallon of water. Such a solution will not injure the foliage and is of sufficient strength.

The extensive or long-continued use of nitrate of soda injures the tilth of the soil, especially of clay soils. This effect may be overcome by adding organic matter or by using acid fertilizers, like acid phosphate or ammonium sulphate.

Sulphate of ammonia is a by-product from gas works and contains about 20 per cent of nitrogen. It does not act as quickly as nitrate of soda; but for late crops, to be applied during warm weather, it is one of the best sources of nitrogen.

Acid phosphate is an acidulated bone meal made by treating ground bone or raw rock phosphate with sulphuric acid, to render the phosphates soluble. These are rich in available phosphoric acid, and some acidulated bone contains a considerable quantity of nitrogen. They vary much in quality. The better kinds are generally used at the rate of about 400 pounds per acre.

Raw rock phosphate, or "floats," is perhaps the most suitable source of phosphorus for market gardeners. The phophorus in this is slowly available, but in a soil rich in organic matter it becomes soluble rapidly enough for the use of the crop.

Wood ashes are rich in potash and are a valuable fertilizer in many cases, provided they have not been leached; if leached greatly they are practically worthless as a fertilizer. Ashes from hard wood are more valuable than those from soft wood, on account of containing much more potash. Ashes are one of the best fertilizers for fruit trees and plants. About twenty bushels of unleached hardwood ashes are generally sufficient for one acre, but much more may be safely used. Coal ashes are worthless for fertilizing purposes.

Kainit.—Potash is also applied to the land in the form of German potash salts, a grade of which, known as kainit, is very commonly used as a fertilizer. These salts are more or less mixed with common table salt and other impurities and form a cheap and very useful supply of potash. They are generally sold on a valuation based on the percentage of actual potash they contain. Kainit contains 13 per cent of potash, which is more than twice as much as there is in ordinary unleached wood ashes. From 200 to 600 pounds of kainit is generally applied per acre.

Lime is found in abundance in most Western soils, but burned limestone freshly slaked may often be used to advantage in small quantities when large amounts of stable manure have been used upon the land for a number of years. It should not be used alone, because it exhausts the soil.

Land plaster is sulphate of lime. It is not a direct fertilizer, but is a soil stimulant. It may occasionally be used to advantage for leguminous crops, such as clover, beans, peas, etc., in applications of from 200 to 600 pounds per acre spread broadcast.

There is little need for commercial fertilizers at present in most of the Western states, and they should never be used until the home sources of manure have been exhausted, and then only to supplement rather than to replace farm manures, and as aids in intensive cultivation of gardens. They are generally expensive, and results from their use in the West have not been as satisfactory as in the Eastern states.

Those who use commercial fertilizers of the better kinds for the first time are very likely to use too much, seriously injuring the crops to which they are applied. It is much better to use too little than too much, and to experiment along this line in a small and inexpensive way to begin with.

Home Mixing of Fertilizers.—Where a considerable quantity of commercial fertilizer is used, it is well to mix it at home, since the grower knows that it contains the elements that he desires in it, and it is not necessary to pay freight on sand or other filler. One is apt also to make more of a study of the effectiveness of the mixture if he is thoroughly familiar with its makeup. Usually the cost is less when the materials are purchased separately. The Massachusetts experiment station gives very clear directions for computing mixtures, which we quote as follows:—

"The calculation of amounts of different materials needed to make a fertilizer of given composition is simple. It is necessary first to know the composition of the materials. This is usually correctly stated by the guarantee. The selection of materials to furnish any given element is determined by relative prices and fitness. For the element nitrogen it is best in most cases to use nitrate of soda, blood, or sulphate of ammonia and something like tankage or fish, thus securing different rates of availability to insure a supply throughout the growing season.

A part of the needed phosphoric acid (rather slow acting) will be furnished by tankage or fish. The balance may be derived either from acid phosphate or slag meal as crop or soil may make best. The needed potash should, as a rule, be derived from high-grade sulphate.

Example Showing Method of Calculation.

Potato fertilizer to contain:—

Nitrogen,	3.5%
Phosphoric acid,	8%
Potash,	10%

Nitrogen at	3.5%	= 3.5 lbs. in 100,	or 70 lbs. in a ton
Phosphoric acid at	8. %	= 8. lbs. in 100,	or 160 lbs. in a ton
Potash at	10. %	= 10. lbs. in 100,	or 200 lbs. in a ton

The materials to be used are:—

Nitrate of soda...........15.5%	nitrogen
Dried blood..............10. %	nitrogen
Tankage, 7. % nitrogen and 8. %	phosphoric acid
Acid phosphate...........14. %	phosphoric acid
H. G. sulphate of potash...50. %	potash

The nitrogen is to come in equal quantities from each of the three materials containing that element, in round numbers, 23 pounds from each.

As 100 pounds of nitrate of soda contain 15.5 pounds of nitrogen, in order to find out how many pounds of nitrate of soda will be required to furnish 23 pounds (one-third of the 70 pounds required) we solve the proportion:—

15.5 : 23 :: 100 : X = 150 pounds, in round numbers

The fish is also to be used in quantity sufficient to furnish 23 pounds of nitrogen, and as 100 pounds of fish contain 10 pounds:—

10 : 23 :: 100 : X = 230 pounds

Tankage to furnish the other pounds of nitrogen is needed. As 100 pounds of tankage contain 7 pounds of nitrogen:—

7 : 23 :: 100 : X = 330 pounds

The 330 pounds of tankage supply 27 pounds of phosphoric acid. We need 160 pounds in all and must therefore use acid phosphate to furnish 133 pounds. As 100 pounds of acid phosphate contain 14 pounds of phosphoric acid:—

14 : 133 :: 100 : X = 950 pounds

As 100 pounds of high-grade sulphate of potash contain 50 pounds of potash, and we need 200 pounds:—

50 : 200 :: 100 : X = 400 pounds

The complete mixture:—

Nitrate of soda..................	150 lbs. furnishing 23 lbs. of nitrogen
Dried blood....................	230 lbs. furnishing 23 lbs. of nitrogen
Tankage.......................	330 lbs. furnishing 23 lbs. of nitrogen and 27 lbs. phosphoric acid
Acid phosphate...............	950 lbs. furnishing 133 lbs. phosphoric acid
High-grade sulphate of potash,	400 lbs. furnishing 200 lbs. potash
	2060 lbs.

It will be noted that we have a small excess above one ton. This is not important and is due to the fact that the nearest round numbers have been employed."

Effect of Manure on Crops.—The proportions of the various plant foods used by different crops vary considerably, some using a larger amount of one element and some of another. The visible effects of the essential elements when in excess in the soil are also quite different. Garden plants that are grown especially for their foliage use large quantities of nitrogen and require it in order to be perfectly healthy, and seed-producing plants use large quantities of phosphoric acid and potash. Where nitrogen in a soluble form is very abundant so as to be in excess in the soil, it will be found that the plants growing on it are noticeable for their dark green color and rank leaf and stem growth, and for late maturity of fruit and seed. In the case of small grain, it may result in such a weak, soft, succulent growth that the stems cannot support themselves and they become "lodged," and such growth may be gained without an increase in the yield of grain. In the case of lawns a soft, thick sod is made; in the case of spinach, cabbage and other leaf crops, vigorous, large plants result; while tree and bush fruits, under such conditions, make a soft, late-maturing growth that easily winter-kills.

On the contrary, when soluble potash and phosphoric acid are in excess in the soil, the plants will have a tendency to produce a large amount of seed and fruit in proportion to straw or wood and to mature early. This is a desirable condition for heaviest grain and seed crops. In the case of bush and tree fruits, it conduces to fruitfulness, early maturity of wood, and hardiness. These qualities will be most evident if the nitrogen is under a normal quantity in the soil.

It must not be understood from this that any of these elements are hurtful, for they are absolutely necessary in proper proportions to secure best results; but these effects follow when they are greatly in excess.

Fresh Manure.—Except in few instances, fresh manure in the garden soil is not beneficial, and its presence hinders intensive cultivation and causes the land to dry out quickly. If applied to certain root crops, such as parsnips, it causes the formation of a large number of side roots, rather than the long, smooth root desired. Fresh manure does not afford plant food for some time, since it must first be decayed before it is of any value to plants. Rotten manure has much of its plant food in an available condition.

Manure for Early and Late Crops.—Much more manure, and more thoroughly rotted manure, is required for early than for late crops. This is undoubtedly due to the fact that early in the season fermentation goes on very slowly, and unless plant food is supplied in a quickly available form it is of no immediate use to the plant. On account of the rapid fermentation which goes on in the soil later in the season, crops that mature later than the middle of the summer may be able to use the plant food that was locked up in fresh manure in the spring. For instance, the results from fresh cow manure may be almost nothing if applied in the spring to a crop of early cabbage or spinach, while for a late crop of cabbage or for corn it may answer very well. Where an abundance of well-rotted manure can not be obtained in the spring and it becomes necessary to use partially-rotted manure for an early crop, it is a good plan to use nitrate of soda or some other quick-acting fertilizer to afford plant food until the manure has rotted.

Manures for Leguminous Crops.—Leguminous crops, such as peas, beans, clover, and alfalfa, do not need as much nitrogenous manure as most other crops, since by the aid of certain bacterium in nodules on their roots free nitrogen of the air is utilized. Such crops improve the land on which they grow by increasing the nitrogen supply, and in this respect they are different from all other garden crops. Legumes are sometimes referred to as nitrogen producers, and other crops as nitrogen consumers.

When to Apply Manure.—The time and manner of applying a fertilizer depend on the plant, the kind of fertilizer, the soil, the amount of rainfall, etc. It should usually be applied in the spring about the time the seed is sown. This is true especially of farm manures and the slower-acting commercial kinds. Nitrate of soda and other quick-acting kinds may be applied when the plant shows by slackened growth that they are needed. There is no set rule as to quantity or kind to apply. This matter must be largely worked out in individual cases.

Animal manure should generally be spread evenly on the land and then be thinly covered with the soil; yet for some crops it may sometimes be most desirable to apply the manure in the hill or furrow. The amount that should be applied per acre varies with the crop, soil, and manure, and so no exact rule can be given. For a midsummer or late-maturing crop, probably twenty-five or thirty tons of well-rotted stable manure per acre would be sufficient in almost any case, and much less will sometimes be enough, while for an early crop twice as much rotted manure might be used to advantage. Well-rotted manure should be covered with soil soon after it is applied to the land. If it is put on frozen land it may waste by the soluble parts being washed away. But in the case of fresh animal manures there is little chance of loss in these ways.

The effect of the application of animal manure to the land will remain apparent for several years, It is generally considered safe to estimate that not more than one-third the full value of these manures is taken up by the crop growing on the land the year it is applied.

Manure the Growing Crop.—Sometimes a crop comes to a standstill on account of having exhausted some available fertilizing material in the soil. In such cases it may be a good plan to fertilize the growing crop with hen manure, nitrate of soda, or other quick-acting fertilizer and cultivate the land at once. This may be done in many cases by applying such materials to the crop during a hard rain, or, in a dry time, by plowing a furrow near the crop and placing the fertilizer in the furrow. But in any case it should be cultivated into the soil so as to become well mixed through it, and much care must be taken to prevent the dry fertilizer from coming in contact with the roots of the plants.

Rotating Manures.—It is a good plan to change occasionally the manures applied to land; i. e. when stable manure has been largely used for some years, apply some commercial fertilizer, and when commercial fertilizers have been used for some time recourse should be had to stable manure.

Liquid Manure.—Liquid manure is sometimes used in encouraging the growth of plants. It should never be made from fresh manure, but from that which is thoroughly rotted. Urine may be used as a liquid manure if well decomposed, but it should always be used with great caution and never applied to plants if fresh or undiluted. Cow and horse manure are generally preferred for making liquid manure. The vessel in which it is to be made should be one-third full of manure and filled up with water. The whole should then be stirred and allowed to settle. The clear water is then used for watering plants.

Liquid fertilizer is also made by dissolving nitrate of soda in water, as mentioned under that head. Ammonia is sometimes used in very small quantities in water applied to plants, especially to house plants, with good results.

REVIEW QUESTIONS

1. What essential elements are sometimes lacking in the soil?
2. What is the difference between direct and indirect fertilizers?
3. Why are manures from young, growing animals less valuable than from mature animals?
4. What causes the heating of stable manure?
5. To what extent are the different farm manures valuable for farm crops?
6. What is the result of mixing alkaline substances with manure?
7. What is the result of mixing commercial fertilizers with manures?
8. How should farm manure be cared for?
9. What is a compost heap, and how made?
10. What are commercial fertilizers, and in what way are they valuable?
11. What is tankage? Nitrate of soda? Kainit? What plant food elements do they contain?
12. What part of the plant does each of the elements nitrogen, potash, and phosphorus affect when in excess in the soil?

13. What kind of manure should be used for early crops, and why?
14. What kind of manure should be used for late crops, and why?
15. How should commercial fertilizers be applied to the land?
16. How should animal manure be applied to the land?

CHAPTER III

GARDEN TILLAGE

Objects of Tillage.—By the proper cultivation of the garden we accomplish three things: (1) The weeds are kept out so that they do not shade or take away valuable plant food and moisture from the plants which we desire to perfect. (2) The surface soil is brought into best condition to resist drought, that is, into the best condition to avail itself to the utmost of the stores of water in the subsoil and to prevent the evaporation of this water from the surface soil. Erosion or washing of the soil is also prevented to some extent. (3) The inert plant food in the soil is made soluble by chemical action, due to the letting in of water, heat, and air by the stirring of the soil.

Prevention and Killing of Weeds.—The methods best adapted for keeping weeds out of the garden are many and varied. They depend much upon the condition and kind of soil in which the weeds grow, and upon the kind of crop and the habits of the weeds themselves. The most important step in making easy the prevention of weeds in the garden is the harrowing or other thorough cultivation of the land just before the planting of the seed, to kill the young weeds. If this is done thoroughly the weeds do not have any better chance than the crop. If this is not done the weeds will be ahead of the crop in growth, and if started ever so little when the crop is planted the result generally is that the crop is seriously overgrown by them before it is large enough to be cultivated.

When garden seeds that require a long time to germinate are sown, it is an excellent plan to rake over the land lightly with an ordinary fine-toothed rake, even before the crop appears above the ground, providing the work is so carefully done as not to disturb the seeds. This is an easy matter in case of the larger garden seeds, while it would be impossible with the finer seeds, as they are invariably planted shallow. When the seed is sown with a drill the line of the row may be plainly seen even before the plants come up, thus making it easy to commence cultivating in

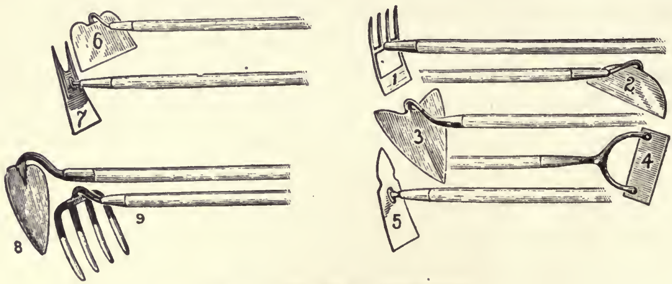

Fig. 8. Types of garden hoes.

advance of the weeds. In case of such crops as carrots, onions, beets, and parsnips, which are quite delicate when young, cultivation should begin with some hand garden cultivator, even if it is intended later on to cultivate with a horse implement and the crop is planted with this purpose in view. Such close and careful work can not be done with any horse implement now in use as with the best hand implements.

Careful early cultivation is of the utmost importance, since if the weeds are removed when they are young the work of weeding is small. If allowed to remain until well rooted, their removal is often a very serious matter, and frequently, if neglected at this early stage, the weeds become so firmly established as to make it a question whether to remove them or to plow under the whole crop; and often it is the part of wisdom to adopt the latter alternative. Aside from its effect in the prevention of weeds, early cultivation is of the greatest value in breaking up the crust that packs firmly around the tender growing stems of plants and which seriously interferes with their growth. Like all surface cultivation it is also an aid in the conservation of moisture in the soil.

Importance of Not Allowing Weeds to go to Seed.—A common source of weed infection is often found in the few weeds that are allowed to go to seed toward the end of the growing season in the maturing crop or after the crop has been gathered. To some persons it often seems a

Fig. 9. Useful types of hand weeders.

small matter to allow a few plants of pigweed, purslane, tumbleweed, and weeds of other kinds to go to seed in the garden, but absolute cleanliness should be the rule in this particular, and it is by far the most economical in practice in the long run. It requires but little labor and saves much useless expense if the weeds that are going to seed are destroyed. If the preventives for weeds here suggested are closely followed, hand weeding will be reduced to a minimum and will often be unnecessary with any crop.

Weed Seeds in the Manure for the Garden.—While the discussion of the subject of manures for the garden is not the special object of this chapter, yet some reference to the subject is quite necessary in considering the subject of weed eradication. The people of this section have not yet learned the great value of barnyard manure and its proper preparation for best results in the soil. This is a subject of vast importance and one that in the future will receive far more thought than at present. The manure applied to the garden is often coarse and contains many weed seeds and is a fruitful source of weed infection. If the manure intended for the garden contains the seeds of weeds it should be piled up and allowed to ferment until the whole mass is thoroughly rotted, which process will kill the weed seeds in it. It is seldom advisable to use fresh manure in the garden, and it should only be applied in this condition when free from weeds and then only for some late maturing crops, in which case there will be time for it to rot before the crops need it.

Fig. 10. Root system of an onion plant with earth washed off. The roots penetrated the earth to a depth of 18 inches.

Plowing.—In the Western states, where the summers are often very dry, vegetable land should generally be plowed in the autumn, so that the subsoil may become sufficiently compacted by spring to readily transmit the subsoil moisture to the surface. Such treatment, by forming a dust blanket, retards evaporation from the land during dry autumns and dry winters when there is no snow on the ground. Fall plowing also puts the land in the best shape for the action of the elements and the development of plant food, and may be a means of killing very many cut worms, white grubs, and other insects that winter over in the soil. If plowing is left until spring in northern climates it should be done as early as practicable and not as deep as when done in the fall. Deep spring plowing leaves too much of the upper soil loose and not sufficiently compact to enable the subsoil water to easily reach the surface roots; but where irrigation is practiced, there is not much difference in this respect. The soil for the garden should ordinarily be plowed to a depth of at least eight inches, yet in the case of some light soils half this depth may be preferable.

Subsoiling is a term applied to the loosening of the land just below where the plow ordinarily goes. The subsoil is not brought to the surface, but a special plow is used which follows an ordinary plow. This has no mold board, but has a good point and shoe, and these loosen the subsoil without raising it. This process may be hurtful or of no value to subsoils already so loose as to permit the roots of plants to push readily into them, and should not be applied to them; but for some of the very stiff subsoils of some sections it is a great improvement, since it deepens the tillable land so that the roots of the plants can push more readily into it. This loosening of the stiff subsoil also puts it into just the right condition for receiving and holding water. It is thus sometimes a great help in carrying plants over droughty periods.

Subsoiling gives best results when performed in the autumn. If done in the spring and the operation is followed by dry weather, the land is likely to be left too loose to hold moisture well that year and consequently will suffer from drought. It is seldom, even on stiff land, that subsoiling is needed more than once in four or five years, for after being once loosened the roots of plants penetrate it and keep it open. The roots of our garden crops push deeper into the land than is generally known; even the onion, which is, perhaps, as shallow rooted as any garden crop grown, often pushes its roots to a depth of eighteen inches in good soil, and corn roots have been followed to a depth of four feet. It is probable that in good land almost any of our garden crops will send their roots eighteen or more inches deep.

Ridging the Land.—If the land is liable to be too wet for planting in early spring, it is sometimes a good practice in plowing it to turn several furrows back to back and thus leave the land in ridges over winter. If these ridges or "lands" are made fifteen or twenty feet wide, they may be dragged and planted in the spring without further plowing. For some crops it is often best to open the furrows again in the spring and thus leave the land level. This method of treatment permits of working the land much earlier in the spring than it otherwise could be worked if plowed flat. It also leaves the soil in very good shape for the action of frost on its particles during the winter. For early crops on flat or heavy soils it is a most desirable treatment. The objection to it is that if not turned back in the spring the dead furrows interfere with cultivation; and if the land is plowed again in the spring, it may be left too loose. But admitting these objections, even then there are often cases where ridging would be very desirable. It should be borne in mind, too, in cultivating the garden, that while the soil in it may be too loose, it can not be too rich or too deep; nor can the subsoil, if not of too impervious a nature, be too compact, and yet it must be loose enough to permit of the roots entering it and the water percolating through it.

General Cultivation of Garden Crops.—The methods to be pursued in the general cultivation of garden crops vary somewhat according to the soil, season, and crop. It is very important to remember, however, that the destruction of weeds is but a small part of the work of cultivation. The most important part in many sections is to so fit the soil that it may best withstand drought. This is accomplished by frequent shallow cultivation during the period of drought. The first implements to use in the care of such crops as are generally cultivated by hand are those that work the soil to only a very slight depth close to the plants. Such implements may be used just as the seedlings are breaking ground.

As soon as the plants have gained some little strength, implements should be used that will go deeper, until a depth of two or three inches can be easily worked without endangering the safety of the crop by covering the plants with soil. It is doubtful if any of our garden crops should ever be cultivated more than three inches deep, and it is very certain that many crops are injured by cultivating deeply very close to the plants, in which case the roots are cut off near their upper ends and thus wholly destroyed.

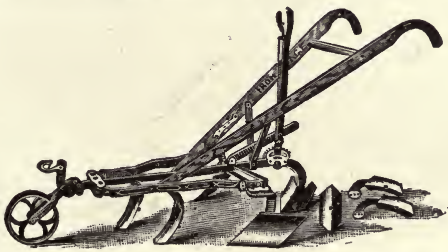

Fig. 11. A useful type of horse hoe.

Cultivation in a period of drought results in forming a mulch or blanket of dry earth on the surface of the land, which prevents the moisture from passing into the atmosphere, and a rather shallow dust blanket, say three inches deep, accomplishes this purpose. A compact subsoil readily transmits the water upwards to the surface soil in the same manner that a lamp wick carries the oil to the flame. At the surface the soil water is prevented from evaporating by the blanket of loose earth, and is thus saved in the upper subsoil and lower and middle parts of the furrow slice for the roots of the crop. Loose surface soil is a good non-conductor of water. During the growth of a crop the surface soil should never be left long with a crust on it, but should be stirred after each rain or artificial watering.

Cultivation to Develop Plant Food.—Nearly all virgin land contains immense quantities of plant food. Professor

Fig. 12. Illustrating the efficiency ot the fine-tooth cultivator.

Snyder has shown that our average wheat-producing soils contain enough nitrogen to raise one hundred and twenty-five successive crops of wheat. But only a very little of this material is ever at one time in a condition in which the plant can take it up; nearly all of it is insoluble. By chemical action and fermentation in the soil, plant food is set free. This is increased and made more complete by admitting air into the soil. Hence the reason for deep plowing in the fall, which allows the air and water to enter and thus develop plant food. This, also, is an important fact to be kept in mind in cultivating land. Where the soil can be kept moist through the summer, deep spring plowing is an advantage in opening the soil to the air; but on account of the liability to injury from droughts to soils thus worked, the practice is generally a poor one for sections having a limited rainfall.

GARDEN IMPLEMENTS

Implements such as plows, harrows, etc., used in preparing land for ordinary farm crops, are also used in fitting land for garden crops. In addition, however, there are a number of tools and implements which are not commonly used in growing the farm crops. These may be roughly classed as follows:—

Fig. 13. A combined harrow and cultivator.

Horse hoes and horse cultivators are much alike in general construction, but each is adapted to special purposes and both are very desirable. The horse hoes are for use when the land is very hard and weedy; they may also be used for ridging the land and drawing the earth from, or harrowing it towards, the plants. For this purpose they have various attachments.

The cultivators are especially for the purpose of stirring the surface soil and forming a dust blanket; they do not remove weeds that are well established. They throw very little soil sideways, and on this account may be used for cultivating very close to small plants. Among the best of these are those known under the names of Planet Jr. and Iron Age.

Hand Cultivators.—There are many good forms of hand cultivators on the market, and they are a necessity in every garden containing over a quarter of an acre. They are made so as to be adjusted to various widths between the rows, and kinds called "straddle cultivators" are made so as to cut on two sides of a row of plants at one time which is often quite an advantage. They also have various attachments for special purposes. Many good hand cultivators are now on the market. Among those most often used are several kinds manufactured by the S. L. Allen and the Bateman companies.

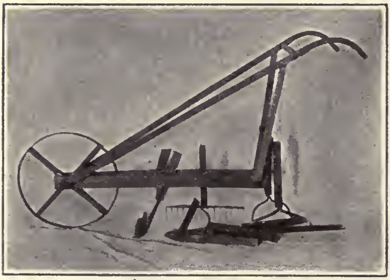

Fig. 14. A homemade hand cultivator.

Seed Drills.—Drills are necessary in every garden. There are many good kinds offered by dealers. Among the best are the New Model drill, Planet Jr. Hill-Dropping drill, Matthews drill, and the Columbia.

Combined Seed Drills and Cultivators.—These are very economical and useful implements for small gardens; for a large garden it is important to have the seed drill and the cultivator separate, but in small gardens combined machines can be used to good advantage, and thereby

Fig. 15. At work with the wheel hoe.

make a saving of first cost. Among the best of these are the combination drill and cultivator made by the Ames Plow Co., of Boston, Mass., and the Planet Jr. combined drill and cultivator.

Marker.—The illustration shows a good form of a

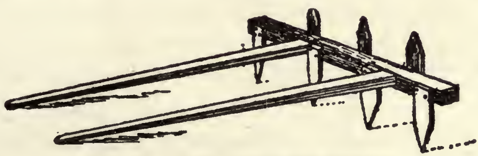

Fig. 16. A simple garden marker,

marker for the garden. It is easily made by any one who is handy with tools, and is used for marking out rows.

Dibbles are generally made from a crooked stick shod with iron, and are very useful in transplanting (Fig. 17). A better form, made of steel, is shown.

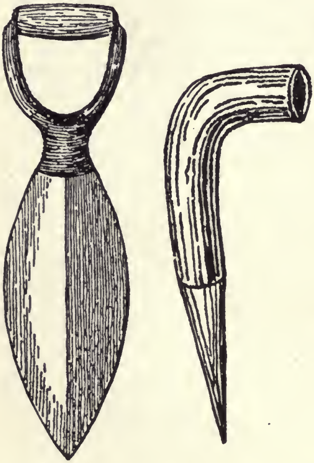
a b

Fig. 17. Dibbles; *a*, improved flat steel; *b*, common wooden.

Scuffle Attachments for Hand Garden Cultivators.—Fig. 18 shows two sets of implements designed to be attached to the ordinary wheel cultivators which will work close up to the young plants so as to cut off the weeds just under the surface of the soil, and will be found very useful in many places. They should be made out of tool steel, and any good blacksmith can make them. The length of blades may be made to suit the work.

The scuffle hoe shown in Fig. 18, is an excellent old-fashioned implement for shallow cultivation, such as is needed in early spring in the garden. Besides it is very cheap and simple and can be made by any handy black-

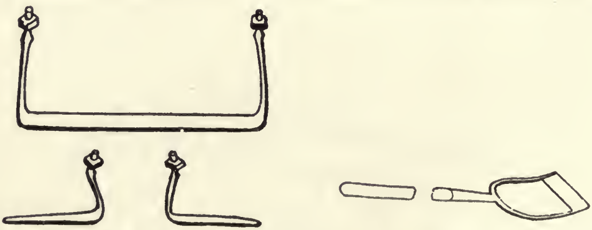

Fig. 18. On the left, homemade attachments for garden cultivator; on the right, a scuffle hoe.

smith. It cannot be recommended to take place of the improved wheel hoes for large gardens, but in small gardens it may be used for the work of shallow cultivation to good advantage. It does not work the soil deep enough for the best summer cultivation.

Plank Drag or Smoothing Board.—The form of this is clearly shown in Fig. 19. It is used for crushing lumpy soil and smoothing off and leveling the land preparatory to seed sowing or planting, and will be found very useful. It can be made by any one. The planks are two by ten

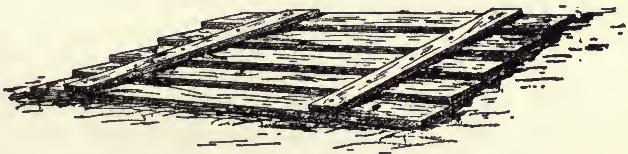

Fig. 19. Plank drag for smoothing the surface of land.

inches on the ends and eight feet long, lapped two inches and nailed. These are strengthened by two six-inch cleats securely bolted on. It is drawn by a chain fastened at the front corners.

Potato Diggers.—Of the cheapest forms of potato diggers, probably the Hallock Improved is the most perfect. It does very good work, and where not over five acres of potatoes are to be dug it is probably all that is needed. Where the potato is raised on a large scale, however, it is generally desirable to use an elevating digger. Of these the Hoover and the Dowden are probably the best to be had. They both work on the same principle.

Spray Pumps.—Almost every farmer and gardener needs a good spray pump for applying Paris green to potatoes and vines and for spraying trees, vines, etc., with fungicides or insecticides. For this purpose some form of the knapsack spray pump is most desirable where the work to be done is not very extensive. For applying these substances on a large scale, some special apparatus is needed, and there are many kinds offered by manufacturers.

In buying machinery it is well to regard with suspicion those that are very complicated, as the simplest is generally the most durable in the end.

REVIEW QUESTIONS

1. What three things are accomplished by cultivation?
2. Why is it important that weeds should be prevented from growing in the garden? What are the best means of eradication?
3. What are the advantages and disadvantages of fall and spring plowing?
4. What is meant by sub-soil plowing, and when does it give best results?
5. What is the object of ridging the land, and when is it practicable?
6. How does cultivation develop plant food?
7. What tools and machines are necessary for successful gardening, and for what purpose is each one used?

CHAPTER IV

SEED SOWING AND TRANSPLANTING

Conditions Favoring Germination.—For the successful germination of seed in the soil a reasonable amount of heat, moisture, and air is necessary. To secure these conditions in practice, the seed should be imbedded in mellow soil, and this packed around it just firm enough to bring it into actual contact and make sure capillary action in the soil. If the soil is left loose over and around the seed capillary action can not take place and the seed is apt to dry out unless the season is very wet; on the other hand, the soil must not be allowed to become too compact over the seed, or the young seedling will not be able to push through it. No matter how carefully the sowing may have been done, the successful germination of the seed is largely dependent upon the condition of the ground. Unless the seed is carefully and properly placed and covered, the crop cannot get a good start, no matter how well the land has been prepared or how good the seed is.

Seed will not sprout in the absence of air, and on this account when deeply buried some weed seeds may retain their germinating power for many years. Cases are on record of yellow mustard seeds germinating after remaining in the land for eighteen years. Very frequently, on plowing land that has not been stirred for a long time, the weeds of certain kinds are very abundant, showing that they must have been in the soil a long time, but could not germinate away from the air.

Depth to Plant.—Most of the common, smaller garden seeds are planted one inch deep; celery and some other fine seeds can not be planted nearly as deep. Peas and corn are generally planted from two to three inches deep. Peas, however, are sometimes planted as deep as six inches.

Always sow in freshly stirred ground, as the seed is far more likely to get a good start in it than in soil that has lain untilled long enough to become crusty and lumpy. Then if the seeds are planted immediately after cultivation has been given and while the soil is still moist, the weeds will hardly get the start of the crop planted if reasonable care is used. In fact, following this rule will generally insure success as long as there is life in the seed and moisture in the soil. Again, it is preferable to sow seeds immediately after a rain rather than just before it comes, since in the case of the finer seeds the crust which forms immediately after a rain may be so compact that the young seedlings cannot push through.

When a crust thus forms over seeds it is sometimes a good plan to go over the land before the crust is very compact and break it up with rakes, but this should be done in a most careful manner so as not to disturb the seeds. If a crust forms over fine seeds, such as celery, and tobacco, it is a good plan to keep the crust moist until the seeds have pushed through it. Soil that is much dried out in midsummer is often quite an obstacle to the ready germination of seed sown at that time; but if the seed is sown shortly after the ground is plowed and somewhat deeper than it is generally sown in the early spring, and care is taken to firm the earth very carefully immediately after sowing, the seed will generally come up very quickly at this season. But the land should not be worked for seed sowing or for any other purpose when very wet and sticky, as seeds can not be properly planted in soil in such condition.

The time of sowing any particular seed varies according to the time we want to use the vegetable, weather conditions, time to market in order to get best price for products, and other circumstances. The time of sowing or planting is given further attention in the separate discussion of the vegetables. Some seeds such as spinach, onion, lettuce, and radish, may be sown as soon as the ground can be worked; while the seed of such tropical plants as corn, cucumber, and squash should not be sown until the ground is well warmed. The early-sown, hardier seeds are often frozen up in the ground and, perhaps, covered with snow without injury; in fact, a covering of snow seems beneficial to the growth of hardy seeds, because land is usually in better shape for sowing seed in after a rain than before.

Sowing in Stiff Clay Soils.—It is comparatively easy to make seeds germinate in sand, sandy loam, muck, or soil rich in humus, provided they contain a reasonable amount of moisture; but in stiff clay soils this is often quite a different matter, as the land becomes crusted over so completely as to prevent the smaller seedlings from pushing through. For such land it is desirable to use rather more seed than would be needed in lighter soils, for the reason that while a few plants could not push up the crusted surface yet many can do so; and while thick seeding increases the total cost of seed, yet the certainty of thus securing a full stand is so great an advantage as to well repay this additional outlay, and the expense for thinning, if it has to be done at all, is about the same for thick as for thin seeding. It is also well to sow in a few radish, or other quick growing seed, in order to mark the rows so that cultivation may commence early. The radish may be pulled as soon as large enough.

Sowing Seed With Machine.—When the soil is prepared for best work with a garden drill, it is generally in the best condition for the germination of seeds. The whole surface should be fine, mellow, and even. There are only one or two garden seeds that cannot readily be sown with any of the half dozen good garden drills that are on the market.

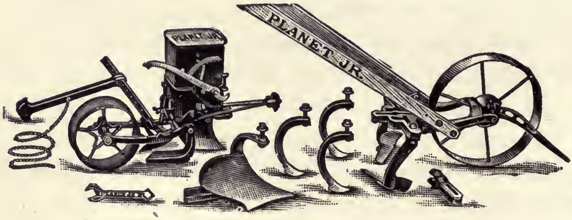

Fig. 20. The Planet Jr. type of combined drill.

Garden drills when properly used will sow and cover seed much more uniformly than it can possibly be sown and covered by hand, and they are a necessity in any well-managed garden of over a quarter of an acre.

It is of the utmost importance to have straight rows in the garden, for they are more economical of space than crooked rows and are more perfectly cultivated with the wheel hoes and cultivator; besides, crooked rows are unsightly and slovenly. It is generally desirable in using a garden drill to mark off the first row with a line to get it straight. If this is done to begin with the subsequent rows may be kept parallel by using the marker always found on such machines, providing constant care is used. Some growers prefer to mark out all the rows with a marker and then run the seed sower in the marks, but for a careful workman this is useless labor.

Seed drills are made with a point to open furrows, a coverer for filling in after the drill, a wheel for compacting the soil on the seed, and a marker for the next row. To use a garden seed drill most successfully requires good judgment, but a little careful experimenting will soon enable any one accustomed to tools to handle these most useful implements to good advantage. Sometimes it is desirable to sow seed when the ground is so wet that it is not safe to firm the soil over it. When such is the case the rear wheel is removed in sowing. In other cases when it is desirable to firm the soil more compactly, the press wheel may be used for this purpose by going over the rows a second time. It is a good plan in doing this to remove the drill point or else tip the machine until the point is off the ground. In the case of a few seeds that are rather delicate when germinating, it is a good plan to sow the rows a second time with the seed drill and thus mix the seed up with the soil. This method puts in a large amount of seed, which is sown at various depths, so that some is sure to grow.

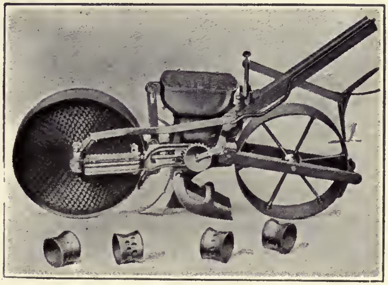

Fig. 21. The Columbia drill.

Sowing Seed by Hand.—When only a very small quantity of seed is to be sown, it is often best to sow it by hand. When this is the plan the rows are made by the garden marker and the seed distributed in them evenly by hand. The rows are then covered by the soil being drawn into them with a rake and are firmed by passing over the seed with the feet. If the soil is dry it cannot be made too firm; if moist, care must be used to prevent packing it too hard. In the case of very fine seed sown in dry weather, many devices are used to bring about germination, such as watering, shading the soil with boards, covering the earth with cloths, and the like.

Shading the Seed Bed.—It is sometimes a good plan to shade a seed bed for a few days after the seed is sown. This is desirable with celery, petunia, tobacco, or other fine seed, since seed of this sort must be covered but slightly with soil on account of their small size. Lath screens, burlap, and cheesecloth make good screens. Remove these as soon as the seed is well germinated. Where flats are used they are often covered with glass to prevent drying out. These are usually shaded with paper during the brightest part of the day. One good watering of a seed bed thus protected is often sufficient to carry the seed through germination.

Using the Feet for Firming the Soil Around the Seeds.—Many seeds are lost from the failure to properly firm the soil over those sown during dry weather. Many devices have been suggested and used for securing this desirable condition, but for general garden purposes no method or implement ever used can vie with the proper use of the feet for this purpose. While this matter is referred to elsewhere, it is put under this special head to call attention to this useful fact.

Peter Henderson was the first to call attention to the importance of this method, and describes it as follows: "After plowing, harrowing, and leveling the land smooth, lines are drawn by the 'markers,' which make furrows about two inches deep and a foot apart. After the man who sows the seed follows another who, with the ball of his right foot, presses down his full weight on every inch of soil where the seed has been sown; the rows are then slightly leveled longitudinally with the rake a light roller is passed over them, and the work is done." Those who have practiced this method know it gives most excellent results. In my own practice, in sowing seed in dry weather, even with a seed drill that has a wheel for firming the soil, I have frequently, and to advantage, walked the rows with the heel of one foot close to and in front of the toe of the other, pressing down on the row.

Thinning.—It is generally best to sow the seed of most garden vegetables much more thickly than the plants should stand when mature. This is done to make sure of having enough plants to stock the land, and it is a good practice. It is important, also, to let every young plant in the garden have room enough for perfect development, and this can only be secured, where thick seeding is practiced, by thinning out. It is a very general fault of beginners in gardening that they try to grow too many plants on their land. This is a common mistake and is no better in result than permitting weeds to grow. Every plant in excess of what can properly mature on the land is in its effect a weed and should be treated as such.

In the home garden, when the thinnings are valuable, as in the case of beets, lettuce, etc., the work of thinning need not be done all at once but as the plants need room. In the market garden it is best to thin out the full distance at one time. Do not allow the seedlings to get drawn and spindling before thinning, but do it while they are young and before they crowd one another. The proper distances between plants seem very large when the plants are small, but it must be remembered that later on anything less than the proper distance injures the crop. One must have determination enough to throw away many nice plants in order to make room for those that are to mature. It is better to give too much than too little room to plants.

Protection to newly planted seeds against insects and birds may often be given by slightly moistening them and then stirring in red lead until all the seeds are thoroughly coated. The seed should be dried before sowing.

Crows and gophers may be kept from eating corn by coating it with coal tar, as follows: Wet the corn with hot water and drain off all surplus. Spread it out about four inches deep on the floor of a warm room and sprinkle it with hot coal tar, using about a tablespoonful to a half bushel of corn, and stir thoroughly until every kernel has a thin coat of tar on it. Then dry the corn by coating it with dry ground plaster or other fine absorbent. This treatment does not seem to hinder germination.

TRANSPLANTING

Transplanting.—Theoretically transplanting is harmful to plants, in that it stops their growth and sets them back. It is performed with more or less difficulty on account of periods of drought that may occur at the time

Fig. 22. A box of young lettuce plants after being transplanted from the seed-box. These plants may be moved to the open ground or to hotbeds or cold frames as soon as they crowd one another. This is a convenient way to grow plants in dwelling houses and in front of windows. This style of box is often referred to as a "flat."

certain plants should be transplanted. It is practically a necessary operation in every garden and florist establishment, for the following reasons: (1) It is easier to take care of a large number of small plants and protect them from disease, insects, weeds, and drought if they are located on a small area than if scattered over the field. (2) Certain crops, such as cabbage, cauliflower, tomatoes, etc., may be started in a small greenhouse, hotbed, or cold

Fig. 23. A device for transplanting lettuce and a seed-bed firmer, in the foreground; hotbeds in the background.

frame much earlier than they possibly could be in the open ground. (3) Better use of land may be made. Plants started in a frame or seed bed may follow a crop that has been sown in the open; as, for example, late celery may take the place of radishes or early peas. (4) Some plants, such as celery, form a fine fibrous root system if transplanted once or twice before final planting in the field. This enables them to become established more quickly in the field and to make a more rapid growth. (5) Transplanting is said to hasten the maturity of some plants.

Some plants will stand transplanting much better than others. Melons, cucumbers, corn, and squash are harder to handle than cabbage, because they do not have as fibrous root systems. They should be handled with a good ball of earth and preferably be grown in pots or on

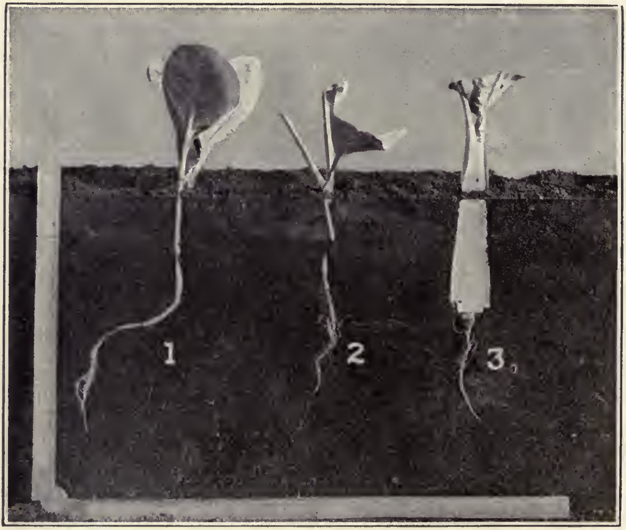

Fig. 24. Showing methods of setting cabbage plants; *1*, with long stem set deeply; *2*, with top of stem twisted off before planting; *3*, wrapped in Manilla paper to protect from cutworms.

sods, so as to disturb the root as little as possible. As a rule, transplanting is more easily performed in humid districts than in the drier sections of the West and Middle West.

Success in transplanting is dependent on a variety of conditions. In moist weather the setting of plants in the open ground is a very simple operation and any one can succeed with it without much effort, but during dry weather the gardener's skill is taxed to the utmost to move plants successfully. One of the most important elements for success in transplanting is a supply of first-class stocky plants that have not been crowded in the seed bed. Such plants make success reasonably certain. A most important requirement in any case is that the soil be moist and not wet and sticky. If it is very dry it must be watered or failure will be a sure result.

Shortening the Tops of Plants.—It is a good plan to shorten the tops of cabbage, celery, cauliflower, and similar plants when they are to be moved. This may be done by twisting or cutting off a third or even one-half of the tops. If the plants have excessively long roots it is a good plan to shorten them enough to permit of their being handled easily.

Fig. 25. Tomato plants grown in a compartment box to facilitate transplanting. Such boxes can be bought at a very low price, and are very convenient aids in transplanting many kinds of plants. They are especially desirable when plants are to be sold at retail.

The digging of plants should be done carefully and every precaution taken to get good roots. The bed should be thoroughly wet before digging so that the small roots will not be broken in separating the plants. If possible, take a good ball of earth about the roots of the plant. This may be pressed tightly to the roots and thus facilitate handling. The best time of day for transplanting is generally after 4 P. M., for after that time the moisture in the air increases rapidly and the plants have the cool night air in which to recover before being subjected to the intense rays of the sun. Of course if the weather is cloudy the plants may be set out at any time of the day. If a little shade can be provided for the newly set plants so much the better. This may consist of boxes, boards slightly raised from the ground, shingles, inverted flower pots, paper bags, a handful of green grass, strawberry boxes, or similar material that will protect the plants from the fierce rays of the sun.

Firming the soil about the roots is fully as important as firming the soil over the seeds, and for the same reasons.

Fig. 26. Transplanting lettuce in the greenhouse—covering.

It should be so firmly and closely packed that the plants cannot be pulled up without considerable effort. The drier the soil the greater the necessity for packing it firmly about the roots. If the soil is wet and inclined to pack hard it should receive only moderate pressure until somewhat dried out. The firming is generally done by pressing with a dibble or the ball of the foot against the soil on one side of the roots of the plant.

When the transplanting is finished it is a good plan to give the plants a good hoeing at once, drawing a little loose, dry soil around them to act as mulch and prevent evaporation. The holes for the plants are generally made with a dibble, shown in Fig. 17. A spade is often used for this purpose, and such plants as small onions are most conveniently set in small furrows made with a wheel hoe. In every case, however, the plants should be set a little

Fig. 27. Transplanting lettuce—firming the soil.

deeper than they grew in the seed bed, and in the case of spindling tomato, cabbage, and some other plants it is a good plan to bend the stems and bury a large part of them in the soil, as shown in Fig. 24.

Hardening off the Plants.—Hardening off is a term used to denote the checking of the growth of plants in such a way as to cause their tissues to become firm and hard. It is very important to have the plants accustomed to cold weather when they are transplanted to the open ground, or they may be killed by a frost that otherwise would do them no harm. This is true of the cauliflower, celery, and of course of all our native frost-tender trees and many other plants. When cabbage plants are properly hardened they take on a dull blue color that at once indicates their condition to one acquainted with their peculiarities. This hardening off of the plants is accomplished by gradually subjecting them to a lower temperature than that in which they grow freely or by drying them a little, thus, finally, nearly checking their growth. The result is a sort of ripening up of the tissues of the plants, and, in consequence, they will stand great hardship.

Substitutes for Flower Pots.—Tomato cans are very convenient substitutes for flowerpots when plants are grown for transplanting. The cover on the end opened may be melted off and half-inch hole made in the bottom for drainage. Another way to use them is to melt all the joints and use the body of the can by tying it together with a piece of wire. Thus prepared the tins may be set in the hotbed or cold frame and filled with earth into which the seed or the plants may be placed. When the time comes for planting into the open ground the tins with the plants in them may be lifted with a trowel and placed in boxes, to be carried to the field where the plants are easily placed in the ground. The

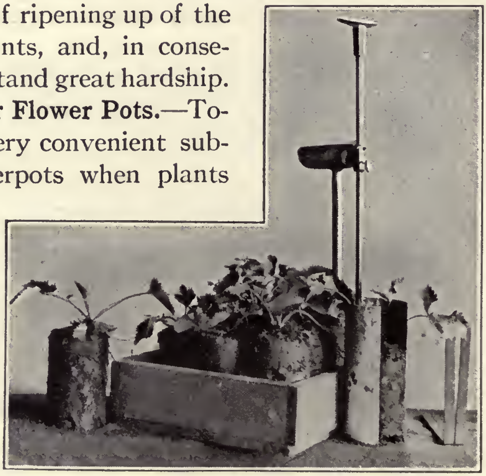

Fig. 28. Transplanting aided by the Balbridge transplanter, which takes up a ball of earth with each plant. This shows a box of strawberry plants just taken up and ready for planting out. In planting out, the holes are made with the same implement. There are several other similar implements for the same purpose.

tins may also be set around the plants on top of the ground to protect them from the sun and wind. (See Fig. 29.) Paper pots are now quite cheaply procured or may easily be made at home. Berry boxes and even sods are often used to advantage.

Fig. 29. Illustrating the use of tomato cans as an aid in transplanting. A box of plants in the cans ready for removal to the field and one can opened, showing the ball of roots. The cans are held together by wire twisted around them.

Machine Transplanting.—Machines are now in use that do the work of transplanting cabbage, cauliflower, tomatoes, and even strawberries better than they can be set by hand and somewhat cheaper. The better makes are simply constructed and easy to handle. They require a good team and a careful driver and two men to feed the plants. The machine opens a furrow, sets the plant, and at the same

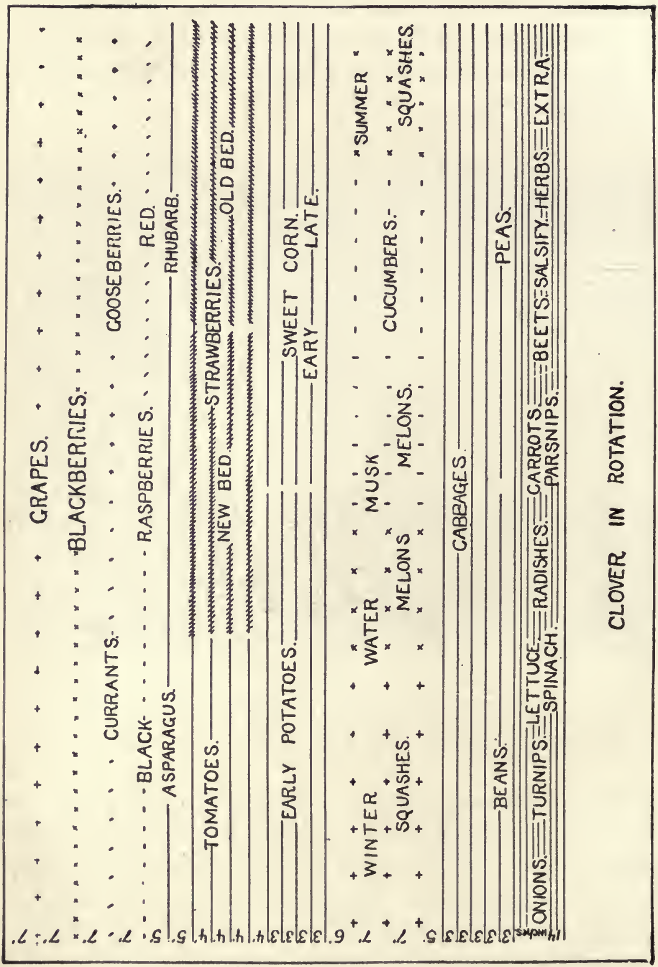

Fig. 30. Plan for a farmer's kitchen garden.

time waters the roots and firms the soil. Plants may be set as close as fifteen inches.

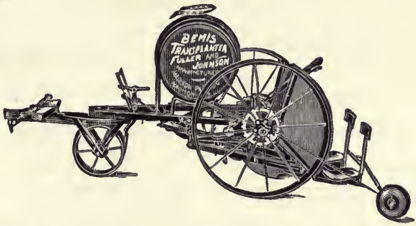

Fig. 31. The Bemis machine transplanter.

REVIEW QUESTIONS

1. What three conditions are necessary for the successful germination of seeds?
2. How deep should garden seed be planted, and what should be the condition of the soil?
3. What are the advantages of sowing seed with seed drills?
4. How should seed be cared for after sowing?
5. What is meant by thinning? Transplanting?
6. What care should be taken of plants after transplanting?
7. How are plants hardened off?

CHAPTER V

SEEDS AND SEED GROWING. DEVELOPMENT OF VARIETIES

Good pedigrees in seeds are of the utmost importance in order to grow good crops. No other single factor that enters into the production of a crop is more important. Where many kinds of plants are grown it is better and cheaper, as a rule, to depend on some careful seed grower for seeds than to go to the expense of raising them, although it may be best to raise a few of the more important kinds of seeds for which one's conditions are best adapted. When one makes a specialty of crops like onions, cabbage, and some other vegetables, it is often advantageous to raise the seed oneself, since their purity and pedigree are then known and no risk is taken about it.

Some seeds can be grown to better advantage in one section than in another. For instance, cauliflower seed cannot be raised profitably in many parts of the United States, but near Puget Sound and in a few other places in this country it can be raised to good advantage. Most of the cauliflower seed used in this country is still imported from southern Europe. As a general rule, however, the seeds raised in one's own vicinity or in a similar climate elsewhere are best to plant if they are properly selected. Experience seems to show that seed grown in cold climates generally produces an earlier crop than seed grown in warm sections.

Testing Seeds.—No matter how carefully our seeds may have been grown or who the person is from whom we received them, it may save much trouble and loss to test them before sowing. This may be done by sowing them in a box of fine loam kept at a temperature of from 60 to 70 degrees. The temperature of an ordinary living room is about right. For this purpose use a box about four inches deep and the size of a soap box; sow the seed in shallow drills and cover the box with glass to prevent rapid evaporation. One hundred seeds should be counted out just as they come, and be sown. By counting the seedlings the percentage of germination of the seed is easily obtained.

A Simple Germinating Apparatus.—A simple method of testing seeds is as follows: Take two plates and in one of

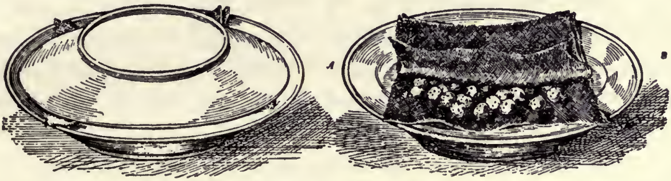

Fig. 32. A simple device for testing seed.

them place a folded cloth,—woolen flannel is preferable, since it must remain moist for a long time,—but any cloth will do. The cloth should be free from dyestuffs, since they may contain injurious chemicals. Wet the cloth, pressing out the surplus water, leaving it very damp, but not soaked. Place the counted seeds between its folds and mark plainly with a pencil on a piece of paper the number of seeds put in and the date. Then cover with the second plate, as shown in Fig. 32. Plenty of air will get in between the plates, and the upper one will prevent evaporation. The temperature should average as recommended. Common newspaper or wrapping paper may take the place of the cloth, but requires much more attention.

Sometimes seeds that barely germinate under the exceptionally good conditions that exist in a warm room or greenhouse will not grow readily when planted outdoors, so that in testing seeds it is very important to note the vigor of the sprouts. Seeds that start strongly in the house may be safely planted at their proper season outdoors, while those that start only weak sprouts indoors may be worthless for outdoor planting. An instance bearing on this occurred a few years ago at Chester, New York, where an onion grower planted seeds three years old which germinated fairly well in his conservatory but failed to grow outdoors, while fresher onion seed sown at the same time grew perfectly.

The curing and storing of seeds are matters of much importance and greatly influence their germinating qualities. Seeds should be thoroughly ventilated while being cured, or they will mold or sprout, either of which seriously injures their value. Seeds of some kinds will sprout several times before entirely losing their germinating qualities, but they lose much of their vitality even by once sprouting. Molded seeds may retain their vitality unimpared, but if to be offered for sale their dark color is objectionable, for it must always be regarded as an evidence of neglect in curing.

It is important also to prevent seeds, especially tropical seeds, as those of melons, squashes, corn, cucumbers, tomatoes, etc., from being frozen until fully dry. The freezing of green or half-cured seeds injures their vitality and often destroys it. This is well known in the case of corn, where the seed taken from an ordinary crib in the spring often fails to grow, while seed corn from the same crop properly cured in a dry, warm room grows perfectly.

Seeds are much influenced by the temperature and humidity of the place in which they are kept. A dry place is absolutely necessary for successfully keeping garden seeds, and if warm so much the better for tropical seeds. The temperature and condition of a good living room are almost ideal for storing all kinds of garden seeds. Most if not all of our garden seeds are unimpaired by even severe freezing when perfectly dried out. In a moist place garden seeds lose their germinating qualities more quickly than when they are kept dry.

Changing Seed.—There are locations so well adapted to certain particular crops that some varieties seem to lose nothing of their pristine vigor and productiveness when grown there for many years, or they may be greatly improved in such locations; but as a rule it is a good plan to change seed occasionally, and it often results in increased productiveness. This seems to be a fact, yet the reason for it is not so plain.

Stock Seed.—When seed-raising is a large business it is out of the question to have all the specimens planted, perfect in every respect, but nothing should be planted except it is near the desired type. Each year enough perfect specimens, or those closely approximating perfection, should be selected to produce the seed for the grower's use the following season. In this way the quality of the grower's seed stock is kept up, and without such care the stock of seed is liable to deteriorate seriously. Seed so selected and improved from year to year is termed stock seed.

Seedsmen's Specialties.—Most seed growers and dealers have some few kinds of seed in which they are especially interested. These they select with more than ordinary care. It is always desirable to order seed of our specialties from those making a specialty of our favorite kinds unless we raise them ourselves. To secure the best it is well to order early in the season.

Seedsmen's Humbugs.—Almost without exception every dealer in seeds sells humbugs, that is, worthless or very inferior varieties. If he is honest he offers them simply because his customers want them. If he is dishonest he is very apt to misrepresent and praise them in order to make customers pay a big profit.

Novelties.—It is desirable to test novelties in seeds and plants, but this should be done cautiously, and, as a rule, it is best not to be in too great haste to try new things. It is the general experience of growers that not more than one in ten of the novelties in seeds, fruits, and plants is any better than those generally cultivated. In the history of the Minnesota experiment station the average of desirable seed novelties has been even less than this.

THE DEVELOPMENT OF VARIETIES

The laws that govern heredity and descent in animals apply as well to plants, and by intelligent selection and breeding one may greatly improve or even originate new varieties of vegetables as well as of other plants. The seed stock of desirable new or improved varieties may often be sold at profitable prices; or by retaining sole ownership of such new or improved kinds one may perhaps raise crops that have highly esteemed qualities as to size, shape, color, flavor, hardiness, season of maturity, or other features, and so command an advanced price. Thus a grower may sometimes be well rewarded for his care and attention in improving his specialties; but careful study and persistence are necessary to success, and few persons are keen enough in their powers of observation, to succeed in this line of work.

There is constant tendency for cultivated plants to vary widely from the original form, though this feature may not manifest itself for many generations after cultivation has *commenced.* The higher the state of cultivation to which a plant is subjected, the higher are the chances of its producing new features. In nature, plants grow under fixed conditions, so they do not vary much. When a plant once commences to vary from the original type, the changes oftentimes come very rapidly, and the possibilities are endless. Thus from a wild plant two or more feet high with only a few leaves has been developed: (1) the modern cabbage of (a) the wrinkled, (b) the smooth, (c) the red-leaved, and (d) the many ornamental kinds; (2) Brussels sprouts, with numerous small cabbage heads on a stem two or more feet high; (3) cauliflowers, in which the inflorescence becomes thick and fleshy; (4) the various kinds of kale; and (5) cow cabbage, which in the Jersey Islands has been known to grow to the height of sixteen feet and strong enough for rafters of cow sheds. The many varieties of garden and field plants are conclusive evidence of the variation of plants under cultivation.

All of our valuable garden vegetables are the result of almost endless care in selection and in a few cases of artificial as well as chance crossing. They must be regarded as artificial productions having a constant tendency to revert to the inferior wild state, which we must constantly try to overcome if their desirable qualities are to be maintained.

It is necessary for the most successful breeding of plants to have in view a well-defined purpose, and in selecting seed not to vary the ideal standard of excellence sought, for such variation increases the difficulty of fixing desired characteristics.

It is found to be quite a general law obtaining among plants *that the qualities of the parent are much more potent and thus more likely to be transmitted than some especially desirable qualities of a few individual fruits which may occur on* *a plant otherwise defective.* For instance, Livingstone, who has done much to improve the tomato, selected seed for fifteen years from the best tomatoes that approached most nearly in size and other qualities the best modern tomatoes, without noting much improvement. He says, "I was then no nearer the goal than when I started. Such stock seed would reproduce every trace of their ancestry; viz., thin-fleshed, rough, undesirable fruits." It finally occurred to him to select from the special merits of the plants as a whole instead of from the best fruits without regard to the plants on which they grow. Improvement then came easily and rapidly, and in a few years he obtained the Paragon, Acme, and Perfection, varieties which were vastly superior to, and which have entirely supplanted, the old varieties of tomatoes. Again, in selecting seed corn it is more important to save seed from plants having ears approaching the desired size of cob, kernel, etc., rather than to select the largest kernels alone or to select from ears after they have been pulled.

When it is desired to hasten the ripening period of a variety, only the seed from the earliest maturing specimens from a plant having the largest number of early specimens should be planted. In order to fix late maturing qualities, seed should be saved from the late maturing fruits on plants possessing these features to the greatest extent.

The continued selection of any seed from inferior specimens results in the fixing of the poorer qualities even more surely than the selection of seed from the better plants results in improvement. By judicious selection the cabbage has sometimes been changed from a biennial to an annual producing no head at all but going to seed the first year. When cabbage has been grown for several generations from stem sprouts and not from head sprouts the effect has sometimes been to lengthen the stem at the expense of the head, until the seed stock becomes run out entirely and is in effect no longer true, modern cabbage seed, since it has partly reverted to the original type. An instance of this occurred in a neighborhood in Nova Scotia, where, for the sake of economy, for a number of years cabbage seed was grown by cutting off the heads and planting out the stumps only, until the stems became nearly two feet long and the heads not much bigger than twice the size of a man's fist.

The practice of sowing the seed from plants remaining in the garden after the best specimens have been gathered for home use, as often happens, is a very poor one. Under such treatment there is a very general tendency for the stock to degenerate. Where seed is to be saved in a mixed garden, a few hills of plants should be allowed to go to seed for this special purpose, without being picked at all. It is very important to save seed from well-ripened fruits. Very immature seeds will often grow, but they give weak though perhaps early-maturing plants, which are very liable to disease. According to Professor Arthur, it is not the slightly unripe seeds that give a noticeable increase in earliness, but very unripe seeds gathered from fruit (tomatoes) scarcely of full size and still very green. Such seeds weigh scarcely more than two-thirds as much as those fully ripe; they grow readily but lack constitutional vigor. Professor E. S. Goff has made a great number of experiments along this line and remarks that the increase in earliness in tomatoes following the use of very immature seeds, "is accompanied by a marked decrease in the vigor of the plant and in the size, firmness, and keeping quality of the fruit."

A few years of careful observation and experience in following out these principles in the breeding of plants with a special object in view, will convince the most skeptical of the wonderful power which man possesses to adapt plants to his needs.

Cross- and Self-pollination of Plants.—The flowers of plants are said to be either self-pollinized or cross-pollinized. By self-pollination is meant the pollination of the female organ (pistil) by the male element (pollen) of the same flower or, in some cases, of different flowers of the same plant, as in corn and squashes, which have two kinds of flowers. By crossing or cross-pollination is meant the pollination of the female organ by pollen from another plant. The crossing of different varieties generally gives increased vigor in the progeny, but its effect is variable and may result in the loss as well as in the increase of their desirable qualities. Most of our cultivated plants are crossed by natural processes. The crossing of different seed stocks of the same varieties of plants is generally a great advantage, since it generally results in increased vigor without loss of desirable qualities. Seeds from self-pollinized flowers are not as productive as crossed flowers. Darwin found that cabbage plants from seeds that had been crossed produced nearly three times the weight produced by self-pollinized seeds.

In the case of Indian corn, experiments made at the Illinois experiment station show that while cross-fertilization is not necessary, it is very desirable. Corn grown from crossed seed in nearly all cases was clearly increased in size as the result of crossing. "Plants grown from self-fertilized seed corn were in most cases notably inferior in size and vigor to the plants grown from hand-crossed seed or from seed simply selected which was probably naturally crossed. One plat from self-fertilized seed had nearly half the stalks deformed in such a manner that instead of standing up straight they turned off at a right angle at or near the point where the ear was produced, thus showing the tassel on a level with the ear. Many of the tassels were very deficient in pollen." In another plot from self-fertilized seed, nearly all the tassels were abortive. All the plants from self-fertilized seed produced a greater proportion of barren stalks or poorly filled ears than plants of the same varieties from hand-crossed seed or from seed naturally fertilized. On the other hand, the flowers of barley and wheat are so constructed that their flowers seldom open and hence are naturally self-fertilized, but even here artificial crossing results in increased productiveness.

The effect of cross-pollination is not always apparent in the progeny of the first generation, but is frequently plainly to be seen in the crossed fruit or seed the first year. Differences may appear, however, as the result of the cross the second or later generation, which were not suspected. When corn is crossed it is generally believed that the effect of the cross is apparent the first year in the grain, but careful experiments plainly show that this is not so, and that flint corn grains which do not show a trace of the admixture of sweet corn the first generation may produce ears the second generation showing some of the characteristics of the sweet corn, and the same is true of other kinds that are crossed. The same truth undoubtedly holds good in the case of other plants.

Mixing Varieties.—Practically varieties of plants can be mixed only in the blossom; and in order to mix the different varieties both must be in blossom at the same time. On this account potatoes do not mix in the hill. The varieties of some species of plants are much inclined to mix. Any two varieties of corn, melons, squashes, and cucumbers are especially liable to be crossed if growing in the same field and in flower at the same time. However, two kinds of corn, of beans, and of other plants may be grown on adjoining pieces of land without danger of mixing, providing that they are not in flower at the same time; e. g., Cory and Evergreen sweet corn if planted at the same time may be grown for seed close together and will not mix, since the Cory would be entirely out of flower when the Evergreen came into flower. Melons and squashes never mix together, for although this belief is widespread the most careful experiments have failed in getting any fruit when the one has been pollenized by the other. Neither do muskmelons and watermelons mix together.

Distance Between Varieties.—The distance which should intervene between varieties liable to mix is variously estimated by different growers and is influenced by various conditions. The pollen of corn, hay grasses, and many other plants is moved by the wind; and when different varieties of corn flowering at the same time are planted for seed there will be more liability of their mixing when the pieces of land on which they grow are in line of the prevailing winds than when east and west of each other. If a grove or hill intervenes between varieties it will often prevent crossing. When varieties of each plant are not on a line of prevailing winds, they are reasonably free from mixing if 500 feet apart; otherwise, at least 1000 feet should intervene.

Such plants as melons, cucumbers, squashes, onions, and most other plants with conspicuous flowers, are pollenized by insects to whose bodies the pollen becomes attached and is thus carried from one flower to another. This pollen is not light and powdery as in corn and many other plants but is rather heavy. It is obvious, then, that the direction of the wind has little effect in crossing such plants. It is generally agreed that different varieties of plants pollenized by insects should have at least 1000 feet between them to prevent mixing, but this will often occur to some extent even with these precautions. The greatest care should be taken to keep stock seed from being mixed.

REVIEW QUESTIONS

1. How are seeds tested?
2. How are seeds cured and stored?
3. What is meant by stock seed? Specialties? Humbugs? Novelties?
4. Illustrate the law that the constant tendency for cultivated plants is to vary widely from the original form.
5. Illustrate the law that the qualities of the parent are more likely to be transmitted than the desirable qualities of a few individual fruits.
6. Why is it a poor plan to select seed from plants remaining in the garden late after the best specimens have been gathered?
7. What is meant by cross-and self-pollination?
8. What is the effect of cross-and of self-pollination?
9. How can the mixing of varieties be prevented?
10. How are plants pollenized?

CHAPTER VI

GLASS STRUCTURES

MARKET gardeners are using the cold frame, hotbed, and greenhouse more and more each year. Some find that they cannot get along without hotbeds or a small greenhouse, or both. Some are giving up the work outside and devoting more of their time to the more extensive work inside. Home gardeners find hotbeds and cold frames of special value in starting early cabbage, tomatoes, celery, and flowers. In some of the Southern states cold frames are used to winter over cabbage and cauliflower. In the Northern states spinach may often be planted in a cold frame in August or September and wintered over, coming on early in the spring.

Advantages.—Some type of glass structure is desirable for the market gardener for the following reasons: (1) to get early plants; (2) to start plants, such as celery, that may be set in the field after other crops; (3) by starting some plants under glass, weeds, insects, and diseases are more easily kept in check; (4) better use of manure in soil can be had under glass; (5) hotbed manure is well decayed and can be used to advantage on many crops; (6) the difficulty of obtaining manure is driving many gardeners to more intensive gardening under glass.

Cold Frames.—The term cold frame is applied to frames covered with glass and used to protect plants in winter, or for forwarding them without any heat other than that derived from the sun. It is the simplest form of glass structure. They are generally made $4\frac{1}{2}$ feet or 6 feet wide and of any length or depth that convenience may suggest. The sashes for covering them are generally 4x4½ feet or 3x6 in size. The location should be near to water and to the house, preferably sloping to the south, and well protected on the north and west by buildings, trees, etc. If there is no protection on the north and west, a tight board fence six feet high will answer the purpose.

In making the bed the following are requisites: Enough 2x12 in. plank to go the length of the north side and the same length of 2x6 in. plank for the south side of the bed, and 2x4 in. stakes, two or more feet long, for each corner and to support the sides firmly in place, and sash and shutters to cover. Boards may be used if planks are not available. The planks should be made into a box with its width equal to the length of the sash and extending east and west. See Fig. 33. The depth of the frame will vary with the use that is to be made of it. If low-growing plants, such as celery, are to be grown, the north side should be twelve inches high and the south side six. If tomatoes are to be started, the north side should be about sixteen inches and the south side ten inches, so as to give head room to the plants. The slope of five or six inches thus obtained permits of quick drainage during a rain and also gives plenty of sunlight. The planks or boards should be nailed to the stakes, and end pieces put in. The outside of the frame should be banked with dirt or strawy manure to keep the interior warmer.

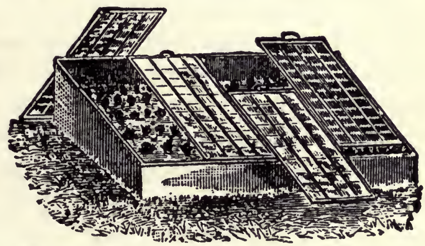

Fig. 33. A movable cold frame, which may be stored out of the way in summer. It is generally made of 1-inch boards, and is very convenient for those using only a few sashes.

The soil in the frame should be of the best quality if plants are to be grown in it. The frame is now ready for the sash and plants. More durable and expensive frames are sometimes made of brick or stone for the sides, and sometimes four-inch strips are put on wherever two of the sashes come together, to serve as a support. Frames are also frequently made several feet deep, but the same general rule applies in the building of them as is here given. Hotbeds and cold frames are sometimes made so that they may be taken down and stored flat. This is an advantage in some cases, since they may be stored in a much smaller space and be better protected over winter.

Cold frames are used in the Middle states to winter over cabbage and lettuce plants. The plants are started in September and planted into them when grown to a good transplanting size. In severe climates this is not a safe method.

Cold frames are used in the North in the spring for forwarding lettuce and other early crops, and still later for melons, cucumbers, and other tropical plants. They are also used to extend the season of growth during the autumn months and to protect some of the half-hardy plants, such as spinach, during the winter. They require ventilation during the day in mild weather, and on cold nights should be covered with mats and shutters or shutters alone. They are very inexpensive and very useful in the garden; but where the materials for making them can be had at low cost, hotbeds are much more satisfactory for forcing vegetables.

Hotbeds.—Hotbeds are made very much like cold frames, only they are warmed by fermenting horse manure or other material placed under the soil, and hence they must be dug out deep enough to make room for it. The amount of manure necessary to properly warm a hotbed will depend very much on the season of the year at which the bed is made up, and the crop to be grown. In the colder Northern states when the hotbeds are made up at the beginning of March, from 24 to 30 inches of manure should be used, and covered with six or eight inches of rich soil. Later in the season 18 inches or even one foot of manure may be sufficient. In favorable locations hotbeds may be used all winter for growing lettuce, radishes, etc. This is not often practicable in the extreme Northern states, and cheap greenhouses are generally used there during winter and hotbeds only during the spring.

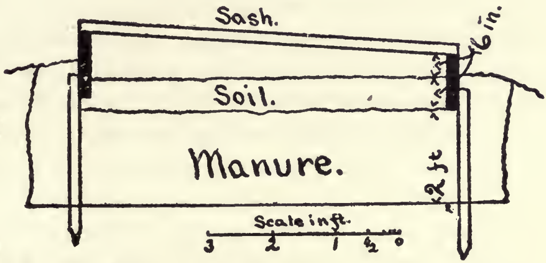

Fig. 34. A cross section of a hotbed.

The hotbed and frames for early spring use should be prepared in the autumn, so that no digging will have to be done in the spring. The soil for spring use should generally be put into them, covered with leaves, and the shutters and mats put on to keep out the frost. If this has not been done the sash may be put on in the early spring, which will partially thaw out the soil in the bed; or, by another method, more manure may be used, putting it on the surface of the frozen land, and the frame may be set on top of it. In the latter case the manure should extend at least one foot beyond the sides of the frame and be one-half again as deep as when placed in a pit, and the frame should be banked up with manure. It is quite common practice to make movable frames of one-inch boards large enough for three or four sash, as shown in Fig. 33. These are kept from year to year, being set on top of the manure and the earth put into them.

Hotbed Manure.—The material generally used for heating hotbeds is fresh horse manure, but sheep manure and even spent hops may serve the purpose. Of animal manures, that from horses fed on highly nitrogenous foods, i. e., on grain foods, will heat best. The preparation of the manure is very simple. It should be gathered together in a pile, as fresh as may be, when if moist it will generally heat, no matter how cold the weather. If it does not start to heat readily, a few buckets of hot water poured into the center of the pile will often start it. When it gets nicely started the pile should be turned over, throwing the outside manure into the center of the pile and breaking up all the lumps. In a few days it will heat again and will then be ready to go into the frames, but do not put it into the frames until it is heating thoroughly. Clear horse manure heats too violently, and should be mixed with about its own bulk of leaves or fine straw. The leaves used to keep frost out of the frames during winter now come in to good advantage for mixing with the manure. Of course, if the manure gathered has considerable straw in it this admixture is not necessary.

The way of putting manure in the frames calls for some little care. It should be broken up very fine, mixed with leaves or other material and spread as evenly as possible over the whole bed, taking special pains to have the frame well filled in the center, as it settles there much more than at the sides. As the manure is put in, it should be packed down quite firmly by the feet, taking great care to have it evenly packed throughout. Now put on the sash and cover until the bed heats well all through. If it does not start to heating quickly enough, a few buckets of hot water should be added. When well warmed through, level off the top of the manure and cover with soil six inches deep. This soil should have been prepared in the autumn and protected from frost by mulching or by putting it under the leaves in the bed; but if this provision has not been made the soil may be searched for in cellars, under strawstacks, in the woods under leaves, or elsewhere, or the soil may be thawed out by the use of sash and manure. As this latter process is tedious, all experienced growers prepare their soil in the autumn.

After the soil is put on it should be left until it is warmed through and the weed seeds near the surface have germinated. Then remove the sashes and make the surface fine with a rake, and the bed is ready to receive the seed. A hotbed made up in this way in March will continue to give out heat for five or six weeks, after which it will be practically a cold frame; but since after the middle of April the sun is pretty high and the bed well warmed, the plants will continue to flourish.

Hotbeds require more water than cold frames and more care in the matter of ventilation. They should not be started until a short time before one is ready to use them. If seedlings are to be raised in them to be later on transplanted, start only enough sashes to grow the seedlings and do not start other hotbeds until the seedlings are big enough to be removed into them.

For the ordinary farm garden four or five hotbed sashes are a great plenty, and no more should be started than can be properly attended to. These should be started about the first of March. This number will be found sufficient for all the early radishes, onions, lettuce, cress and other greens for the table in early spring, and for raising tomatoes, cabbage, and other vegetable plants to be set out later in the open ground.

Shutters and mats are used for covering the sash of hotbeds and cold frames at night to prevent too rapid radiation of the heat.

Fire Hotbeds.—Horse manure will undoubtedly continue to be used for warming hotbeds, no matter how much greenhouse construction or means of artificial heating may

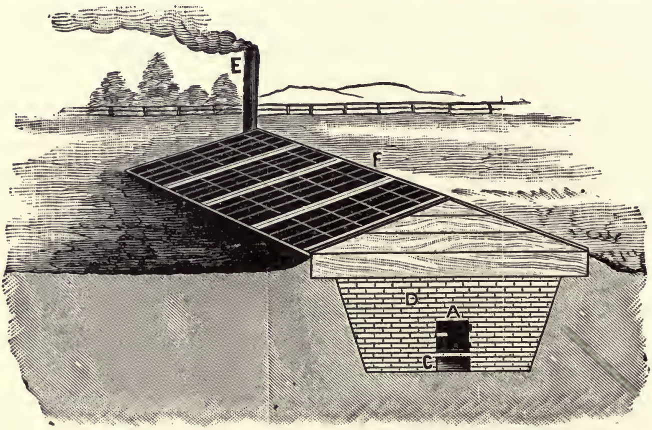

Fig. 35. A fire hotbed.

be cheapened, but there are some situations where it may be more economical and convenient to use a forcing bed or what is sometimes called a fire hotbed. This closely resembles a hotbed in outward appearance, but instead of being heated with manure a flue is used to take its place, and it is warmed by the smoke of wood, coal, or other fuel. In this case a pit should be excavated, furnished with permanent walls and a good strong floor to support the soil in which the crops grow. Ten-inch terra cotta or glazed drain tile is a cheap material for the flue, or brick may be used for this purpose. The furnace and the first eight or ten feet of the flue should be made of common hard brick and have a lining of fire brick set in fire clay.

If the pit is not over thirty feet long the fire box should be at one end and the chimney at the other; but if much longer it is better to have the chimney over the fire box and to run the tile to the end of the house and return back to the chimney. This chimney should have dampers so arranged that when kindling the fire a direct draft may be had into it, and after starting the fire the heat and smoke can then be forced to go through the whole length of the pipe. This arrangement is desirable on account of the difficulty in getting a draft through a long, flat, cold flue. In laying such a flue, it should rise slightly throughout its whole length from fire box to chimney.

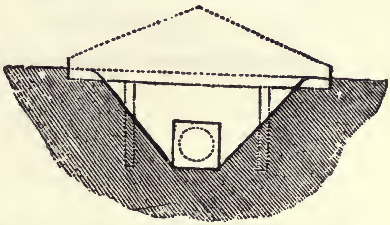

Fig. 36.

The furnace should vary in size according to whether coal or wood is to be used for fuel. For wood the furnace should be 18 inches wide and be arched over the required length, generally 4½ feet, with cast-iron grate bars set in the walls. There should be an ash pit of suitable size, and both it and the fire box should have suitable iron doors set in brick. The accompanying illustrations show the general arrangement of such a house. It is a good plan to build a low shed for fuel on the end where the furnace is located.

The heat from a flue is very dry, and much more water is required when hotbeds are heated in this way than when manure is used as a source of heat.

A Greenhouse Hotbed.—A greenhouse may be heated by manure or a combination of manure and other artificial heat. In the following lines and illustrations is given the plan of what may be called a greenhouse hotbed which has

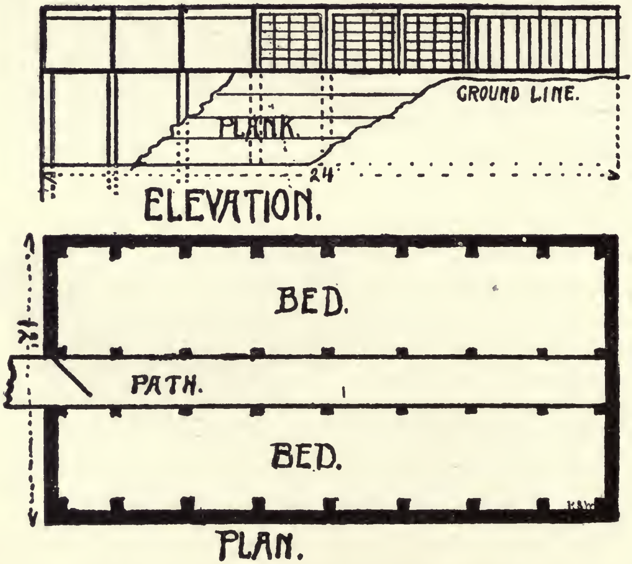

Fig. 37. Plan and elevation of hotbed greenhouse.

been in very successful operation at the Minnesota Agricultural School. The description is from an article on the subject by R. S. Mackintosh, Extension Horticulturist.

"There are disadvantages in hotbeds, as, for instance, the transplanting, ventilating, watering, etc., must be done from the outside even in severe weather, while in a house like the one shown in the figure these operations can be carried on easily. The house is simply a hotbed built so as to allow a person to go inside to do all the work of caring for the plants. Fig. 37 shows the general plan of the house. The size is 12x24 feet. The roof consists of sixteen sashes, each 3x6 feet. Any number of sashes may be used according to the size of the house desired. To receive the most sunlight the house should extend north and south; the light will then strike both sides of the plants. The south end of the house is glazed from the surface of the bed up to

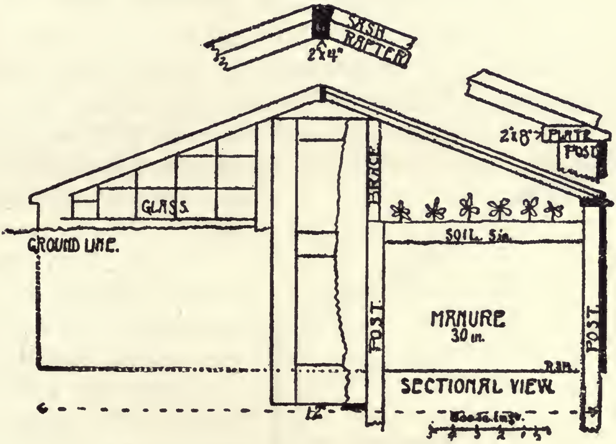

Fig. 38. Sectional view of hotbed greenhouse.

the rafters. It is not necessary to excavate the full depth of four feet, because the earth that is thrown out can be used to bank up with on either side, making a terrace as sloping as desired.

"The heat is furnished by two to three feet of well-prepared manure in each bed, over which is placed five inches of soil. The sashes are fastened to the rafters by screws which prevents their being lifted by heavy winds and at the same time allows them to be removed very easily when desired to replace soil or manure. Ventilation is provided for by fastening one or more sashes with hinges at the bottom so they may be raised as high as necessary at the top.

"Many kinds of building material may be used in the construction of the wall, beds, etc. Lumber is used in the building shown in the figure, but brick or stone would be more durable, though it would add considerably to the first cost. The posts are three feet apart, extend about two feet below the planks, and are braced. The inside rows of posts need not be quite as strong as the outside ones, and need not be braced. When a house is not more than twenty-four feet long it will not be necessary to support the roof in more than one place. This is done by extending two of the middle posts to the rafters.

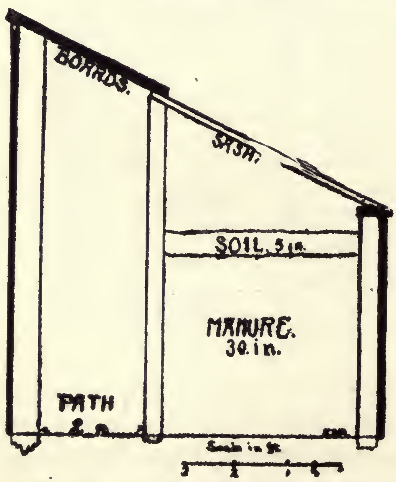

Fig. 39. Cross section of lean-to greenhouse hotbed.

"In Fig. 38 is shown a cross section of this greenhouse and the way the sashes and rafters are joined at top and bottom. The sashes are cut so as to fit tightly at the top and the plate is beveled a little so as to allow water to run off quickly.

"There are sixteen wood shutters for covering the sashes on cold nights. These are made the same width as the sashes but six inches longer. One cleat is put on the upper side at one end, and the other on the lower side at the other end. When put on, the upper cleat is against the ridge pole, which leaves the shutters clear for the water to run off. They are made of second fencing matched and dressed.

"In this house there is glass over the path, which is not necessary in the lean-to plan, shown in Fig. 39, where the sash is all on the south side of the path. It is important to have crops grow as close to the glass as may be, and this fact should be carefully borne in mind. This style of house is susceptible of many modifications. It may be used as a lean-to on the south side of the dwelling, where it may receive a little heat from the house. Its limitations are about the same as those of hotbeds. When such a house is intended for use in winter, it might be an advantage to so plan it that the manure from one-half could be renewed every five or six weeks."

GREENHOUSES

Greenhouse is a term applied to glass structures of the larger sort having special heating apparatus and used for growing plants. Interest in the greenhouse growing of plants has increased very materially in the last few years, and there are many gardeners who manage from a few thousand feet of glass up to several acres.

The advantages of greenhouses over hotbeds lies in the ease of working and of controlling climatic conditions under them as compared with hotbeds. They are easier to heat, and if installed with the Skinner irrigation system, are easier to water. They represent a very much greater investment than hotbeds, but two or three more crops can be taken off than is possible with hotbeds. Well managed, a greenhouse can be used at least ten months of the year.

Types.—There are at least three distinct types of houses as regards construction: lean-to, even-span, and three-quarter. To this we might add one known as the side-hill greenhouse. This is cheaper to build, but rather hard to manage, from the fact that it is on uneven ground. The lean-to house is usually placed next a building as a lean-to, but is not as satisfactory as the even-span or the three-quarter-span house. Usually the even-span house should run north and south and the three-quarter-span east and west to make the best use of sunlight. But this is not so important if part iron construction is used, which allows more light to get into the house.

Materials.—Greenhouses are constructed of cypress, concrete, and iron. The all-iron construction is probably not as serviceable, especially in the north, as the semi-iron or the wood. It costs one-third to one-half more to build in the first place and is more subject to weather changes, than the wood or the semi-iron house. Glass should be of double strength. The smaller single strength is more imperfect and more apt to break. It is well to use as large glass as possible, since on account of fewer sash bars more light is let into the greenhouse. Sizes ranging from 14x16 to 20x24 inches are used.

The houses should be well painted when put up and frequently painted thereafter. Provision should be made for plenty of ventilation by installing some simple and effective system. The size of the house will vary with the use it is put to and the amount to be invested. They are constructed from 18 to 30 feet wide and may be of indefinite length. The crop grown will determine the kind and location of benches.

Hot water is perhaps the best heat, but is often too expensive, and so steam is used very generally.

A very cheap yet serviceable greenhouse is described in "How to Make the Garden Pay," and the publishers of it have kindly consented to the use of it here. It is called the "Model Forcing Pit." Fig. 40 shows a cross section of this house, which is made with a valley in the center, so that in point of fact it is two houses. The total width of both houses is twenty-six feet. The alleys are dug into the ground in each house eighteen inches wide and eighteen inches deep and boarded up on each side. The beds on each side are four feet wide, and the attendant can cultivate them when standing in the alley. The peak of the greenhouse is only four and a half feet above the ground level or six feet from the bottom of the alleys. The sides are only one foot above the ground, and are made of plank nailed to cedar posts and banked upon the out side with horse manure in winter. The roof is covered with moveable sashes 7 or $7\frac{1}{2}$ feet long and of any convenient width. Common hotbed sash (3x6feet) might be made to answer, but sash having larger glass than is generally put in them is best. Large sized glass is preferable, 12x16 inches being a good size. A light framework for the sash to rest on, similar in construction to that shown in figure of a greenhouse hotbed is necessary, and the sashes should be screwed down and ventilation secured in the same way as there explained. At *B*, where the two roof sections meet, the sashes rest on a plank 12 inches wide cut out $\frac{3}{4}$ by 8 inches, to form a gutter to carry off water, as shown in Fig. 41. The center planks rest on two rows of 2x3 inch posts, two and a half feet long and twelve inches above the beds; these posts are four feet apart in each row.

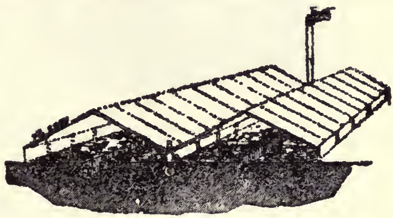

Fig. 40. Market gardener's greenhouse.

The total length of the houses here described may vary according to circumstances. The house from which this plan is taken was 100 feet long. It was heated with a second -hand tubular steam boiler, which at an outside temperature of zero has to carry about five pounds pressure to maintain a temperature of 65° or 70° F. Two inch pipes conduct the heat from the boiler, one line of pipe running up each side of the house and both returning through the center at *B*, back to the boiler. The furnace room is an excavation 10x12 feet and six feet deep at the north end of the house, built with a good wall and roof. The length of pipe required is 450 feet. In the extreme northern states, more pipe radiating surface would perhaps be required for best results.

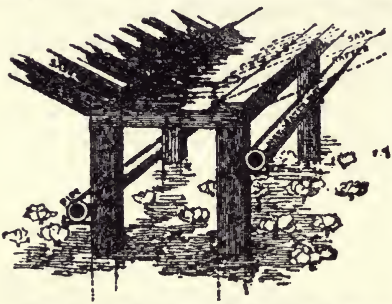

Fig. 41. Valley in market gardener's greenhouse, showing the way the sashbars are attached to the plate.

The entire cost of material for a structure of these dimensions, boiler and pipes included, amounts to about $450. The cost of steam fitting will have to be added to this, but the rest of the work can be done by any man of ordinary intelligence. Mr. Greiner, whose description has been largely followed in the above, says that he likes the pipes all above ground, as here recommended, for forcing vegetables; but if wanted for starting seedlings and for general propagating purposes the pipe had better be placed ten to twelve inches under the surface, and encased in an ordinary three-inch drain tile as shown at *D*, Fig. 40. In sections where fuel is high priced the beds might be partially heated with manure.

Fig. 42 shows a cross section of a lean-to house that is easily adapted to most locations, but especially suited to sidehills. It is twenty feet wide and may be made of any length desired. It should have a boiler room on one end or at the back side, as is most convenient. It should, of course, extend east and west so that the slope will be entirely to the south or southeast. The walls are made of cedar posts tightly boarded up on both sides. The alleys

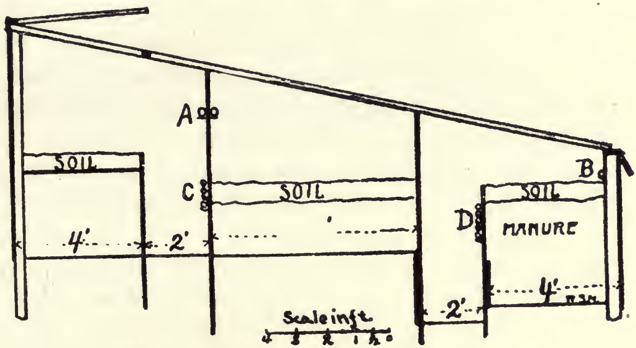

Fig. 42. Cross section of lean-to greenhouse.

are two feet wide and planked on each side. The roof is shown made of permanent sash bars, but these might be made of movable sash, as recommended for the model forcing pit. One ventilator is at the top of the roof and another is in the side wall. Two purlins extending the length of the house are supported by small gas-pipe posts. The north bench is four feet wide, raised three feet above the alley, and is filled with six inches of soil, or it may be used for seed boxes. The center bench is eight feet wide and may be solid or raised. The south bench is shown filled with stable manure, and is practically a hotbed.

The same treatment may also be given the center bench. But where the plan is followed of making up a part of the benches with manure, it is well to have some or all of the roof glazed with movable sash, to facilitate the work of putting in and taking out the manure. The use of stable manure to supplement the heating apparatus is a practice that may be economically followed in locations where coal is high priced and stable manure abundant. The heating arrangement could be either steam of hot water with the flow pipes high up near the roof, as shown at *A* and *B* and the returns at *C* and *D*.

Methods of Heating.—There are practically three methods of heating greenhouses; viz., by smoke flue, by hot water, and by steam. Heating by smoke flue is described under the head of fire hotbeds. It has the merit of being easily and cheaply constructed by anyone having some little ingenuity. Even when made on the best principles it is probably more wasteful of fuel than a good steam or hot-water apparatus, but where inferior fuel can be cheaply obtained a smoke flue may often be used to advantage.

As for the relative merits of hot-water and steam apparatus for heating, it is probably enough to say that each system has its earnest advocates and that very often there is little advantage in favor of either. Where a very large heating plant must be used, making a night watchman necessary, it is best to plan for steam heating at low pressure. For small greenhouses, perhaps a hot-water plant is best. It costs more to put in the hot-water apparatus, because it requires more radiating surface, since the pipes are not heated as hot as when steam is used.

Some exclusive merits are perhaps justly claimed for a combination of hot-water and steam, in which system hot-water is used for heating in mild weather, and in severe weather the water is lowered in the boiler, a regulator is put on, and the pipes are filled with steam. It is probable that an ordinary tubular steam boiler is the most practical kind to use either for a hot-water or a steam heating apparatus.

The amount of radiating surface necessary for heating a greenhouse will depend on the temperature to be maintained and the location of the house. In a general way, one should figure that glass houses will require at least four times as much radiating surface as an ordinary dwelling house similarly situated and enclosing the same number of cubic feet of space. In estimating the amount of radiating surface necessary it is always advisable to consult some practical person acquainted with such problems.

MISCELLANEOUS MATTERS CONNECTED WITH THE BUILDING AND CARE OF HOTBEDS AND GREENHOUSES

The sash for hotbeds or cold frames should be about 3x6 ft. or 4x4½ ft. in size; the glass free from blisters, of double strength, and lapped not more than one-fourth of an inch. If lapped more than this, water is liable to freeze the laps and crack the glass, and dirt will collect between the glass. It should be bedded in putty and nailed in, not puttied in. Common window sash might be used for the purpose in a small way and temporarily, but it is not strong enough to last well; and besides as the sash bars run both ways and project beyond the glass the rain water cannot run off, but soaks the wood and leaks through into the hotbed, making it too wet in places. Also, the cross bars in common window sash make a needless extra shadow that is objectionable. Regular hotbed sash is made with sash bars running only one way so that the water falling on it runs off easily and quickly. Hotbed sash can be bought of sash manufacturers or may be made at home by any person having a fair amount of mechanical ingenuity.

Shutters are desirable for covering the glass of hotbeds and cold frames. They are generally made of second fencing, matched and dressed, and in size of the same width as the sash but about six inches longer with a six-inch cleat on each end.

The mats are often made of straw, but cloth and burlap mats are sometimes used. Straw mats are probably as good as any kind and are easily made as follows: Make a frame of 2x4 inch lumber the size of the mats desired; four feet wide and one foot longer than the sash is a convenient size. Stand this frame up against a wall and tightly stretch four or five tarred strings eight to ten inches apart from top to bottom so as to evenly divide the four feet of width. Have as many balls of lighter tarred strings as there are strings fastened to the frame, and fasten one to each upright string at the bottom. Commence at the lower end by laying a wisp of straw, cut ends out, on the string at the bottom and fasten it there by twisting each of the smaller strings once around the straw and the upright strings. Next put on another wisp of straw, and so continue until the frame is covered.

Mats thus made are an admirable protection against frost and are far better than shutters alone. The advantage of having shutters in addition to the mats is that they keep the mats from getting wet, when they are so heavy that they break easily in handling or they freeze solid and do not lie close or are clumsy to handle. Rye straw is best for mats and it is most tough and durable when cut partially green. It is often threshed by hand so that the straw can be kept straight, but it may be cleaned by a threshing machine by holding the bundles and putting the heads only into the machine.

Ventilation and temperature are subjects of greatest importance in growing plants under glass. The various classes of plants require different degrees of heat to reach their best development. For instance, lettuce, radish, cress, and similar plants grow best at a low temperature, say about 75° F. in the day and 40° to 50° at night, and may even be frozen without serious injury; while tomatoes, eggplants, cucumbers, and melons grow best at the higher temperature of 85° to 90° in the day and 60° at night. If the former plants are kept at a higher temperature than that given they are liable to become diseased and infested with insects. This is especially true of lettuce. On the other hand, if the high-temperature plants are kept much cooler they become sickly and weak, although tomato plants will grow in quite cool temperature. In admitting air to glass structures care should be taken that the wind does not blow in on the plants. This is generally best accomplished in hotbeds and frames by blocking up the sash at the ends or sides with notched pieces of wood.

The temperature of any place, unless otherwise specified, is the temperature there of a thermometer in the shade. A thermometer with the full sunlight shining on it will record about fifteen degrees higher than in the shade, which is a point always to be borne in mind in ventilating.

In the weather of early spring when the sun is getting high, the middle of the days will be very warm and the nights still quite cool and frosty. It is then that a beginner often makes the mistake of leaving the sashes of his hotbeds open late in the afternoon, and the beds cool off more than is desirable. At this season of the year but little ventilation is necessary, and frames and greenhouses should be shut up quite early in the afternoon, and the covering put on to retain the heat as soon as the sun is low. In the warm weather of later spring, the sash of the hotbeds and frames may be removed in the day and kept on only at night. No exact rules can be laid down for ventilating, but it is quite a simple matter to learn if one is observant and uses constant vigilance. Many persons just beginning to use greenhouses and hotbeds fail to get best results from them because they neglect the matter of ventilation. On cloudy mornings it may not be needed, but if the sun comes through the clouds it may warm the house or the beds in a very short time, so that when they are examined the whole crop has been injured by the heat. This is a most common cause of failure by amateurs in charge of greenhouses and hotbeds.

In nature the night temperature in which plants grow averages from fifteen to twenty degrees below that of the day, and it has been found in practice that when this condition is reversed the plants do not do well. This, of course, can be easily avoided by a little forethought. It is a bad plan, generally speaking, to ventilate much in cold weather when the leaves are wet. On this account it is best to water early in the day, so that the leaves may dry off before much ventilation is required.

Watering.—Plants that are growing slowly do not need much water, while those that are growing vigorously need a great deal of it. Growing plants need water whenever they are dry. In bright, warm weather a rapidly growing crop in hotbed or cold frame will need watering every day, while in cloudy, moist weather perhaps no water will be needed for a week. In fact, watering in cloudy weather seems to encourage disease. When applying water see that the soil is wet as far down as the roots extend. It is only the beginner who just wets the surface soil and thinks the plants sufficiently watered. If plants are wilting for want of water in the soil give it to them no matter what time of day, but it is always a great advantage in such cases to shade as well as water them if the sun is shining. If a long continued spell of cloudy weather is followed by a period of bright sunshine, it is not uncommon to see plants wilting that have plenty of water in the soil surrounding them. In such a case it may be desirable to shade them somewhat in the middle of the day until they get used to the sunlight.

The leaves of lettuce and some other plants are liable to burn if watered when the sun is shining brightly on them.

In cold weather it is a poor plan to water most of our plants at night, since the water will cool off the air, and the plants may be checked in growth; but in hot weather the reverse is true and plants seem to get more benefit from a good soaking in the evening, when they can have all night to take the water in, than if it is applied in the morning and followed by a hot sun. In watering hotbeds in very cold weather use a fine rose sprinkler and, if practicable, tepid water. At other seasons good lake or cistern water is perfectly safe, and is generally used by commercial growers at all seasons of the year. Avoid getting the soil water-soaked.

The soil should vary somewhat in texture for different plants, but all garden vegetables will flourish in much the same kind of soil. For use in glass structures a light, friable, rich sandy loam is best. This is easily obtained when one has been using hotbeds, by mixing some of the old rotted manure which has been used for heating them the preceding year with any good sandy loam. If sandy loam cannot be had, clay loam may be used and sand added to the mixture. The manure from old hotbeds is especially good for this purpose, and should form about one-third of the bulk of the soil.

Boxes.—In the case of many plants having small seeds, it is a good plan to start them in boxes instead of growing them in beds, on account of the better care that may thus be given them. When plants are to be marketed it is often best to grow them in the boxes in which they are to be sold. Frequently, too, where plants are started in the greenhouse and then moved to the open ground it is most convenient to have them in boxes. For this purpose boxes should be about four inches deep and the size of a soap or cracker box, which may be cut down for the purpose and thus make very cheap boxes. Of course where the market demands a certain number of plants in boxes, they will have to be made for the purpose. The lumber for these can be obtained at any box factory, and what would perhaps be otherwise idle moments may be used in putting it together at a trifling expense.

Substitutes for Glass.—Frames of the same size as hotbed sash are sometimes covered with prepared cloth or paper substitutes for glass. Such covering, however, will not allow the sun's rays to penetrate it easily nor is it so effective in preventing radiation of the heat as glass, but under some circumstances it may be very desirable. Sash thus covered may be often be used to advantage in the latter part of spring by alternating it on the frames and thus doubling the amount of sash at small expense. Or they may be used in the warm weather of spring when the sash needs to be removed entirely in the middle of the day. They are excellent for covering beds filled with recently transplanted crops, since the light is less intense and evaporation less under them than under glass.

A convenient way of forming these sashes is to make frames without sash bars but with one or two wires stretched across them to support the cloth or paper covering.

Unbleached heavy cotton cloth may be used for this purpose, and the material for dressing it should be made of three pints pale linseed oil, one ounce acetate of lead, and four ounces white resin. Grind the acetate in a little oil, and then add the resin and the rest of the oil. Melt in an iron kettle over a gentle fire until well mixed, and apply warm to the cloth. When paper is used it should be what is known as manila wrapping paper. Paste this firmly and tightly on the frame with fresh flour paste. Dry in a warm place. Then wipe the whole of the paper with a damp sponge to cause it to stretch evenly. Dry it again, and apply boiled linseed oil to both sides of it, and dry in a warm place. Use linseed oil that is free from cotton-seed oil.

Shading the Glass.—In the hot weather of late spring or summer the sunlight is too warm for many plants in the greenhouse, and it is customary to shade them. The amount of shade necessary will depend somewhat on circumstances. This shade may consist of lath screens laid on the roof, but more commonly it is given by sprinkling the glass on the outside with a wash made of white lead and gasoline, put on with a spray pump or syringe. This is easily and cheaply done. It will generally come off by autumn or may be rubbed off with a coarse rag or brush. Whitewash is sometimes used for this purpose but it is too easily washed off by heavy rains to be desirable.

SOME THINGS TO REMEMBER IN CONNECTION WITH BUILDING GLASS HOUSES FOR PLANTS

(1) All joints should be made tight and so far as possible so placed that water will not lodge in them.

(2) There should be just as much room in the beds and as little in the paths as possible.

(3) The glass should be as close to the beds as it can be and allow room to manage the crops grown in them. It should be of larger size for greenhouses than for hotbeds and in size not smaller than 10x12 inches, laid on sash bars 11 inches apart. The larger the glass the better. There is not so much breakage in large as in small glass.

(4) A permanent water supply is very desirable.

(5) The glass should be of good quality, free from blisters, bad waves, or other imperfections, and be what is known as double-strength glass.

(6) The heating arrangements should be sufficient to heat the house easily in coldest weather; in other words, it should be more than sufficient to maintain the proper temperature if crowded.

(7) Having the heating plant insufficient and then crowding it in severe weather, injures the heating plant and wastes fuel besides being a trial of patience.

(8) The ventilators should be large and carefully fitted so they will close tightly. When in the roof they should be open at the top. If they open at the bottom the moisture that condenses on the glass forms an ice ridge on them in cold weather and prevents their shutting tightly.

(9) The smaller the sash bars and framing material in the roof the more sunlight can reach the crop.

(10) The greenhouse roof may be covered with movable sash, but it is generally found most desirable to use permanent sash bars. Where severe hailstorms are frequent it might be well to use movable sash and take them off in the summer, but such places are rare exceptions. It requires a very severe hailstorm to break double strength glass, when at an angle, as in a roof, and practically there is little risk from this source.

(11) In the framing of greenhouses, for instance, for purlins and posts gas pipe can be used to good advantage. It is cheap and durable.

(12) All joints should be painted before being put together; all wood and iron work should be kept well painted.

(13) If putty is used in glazing the glass it should be bedded in it and nailed in, in this way: paint the sash bars, and then run a thin coat of putty along them; bed the glass in it, commencing at the bottom of the sash and lapping the glass one-fourth of an inch, on the same plan that shingles are laid on a roof. Fasten the glass with round three-quarter inch brads, using four to each glass; put more liquid putty along the glass next to the sash bars and smooth it off with a knife even with the glass.

(14) Liquid putty is made by mixing one-third boiled linseed oil, one-third white lead, and one-third common putty. If too thick, as may be the case in cold weather, add a little turpentine or benzine. It may be applied with a brush, but the best way is to put it on with a bulb bought for the purpose; or a bulb may be made with leather, having a large quill through which to squeeze the putty. In the latter case there must be a hole in the side or end by which the bulb is filled and which may be drawn together by a string.

(15) Perhaps the most popular way of setting glass in greenhouses at present is by using square glass and butting the ends together. To do this to best advantage, no nails or putty are used and a special wooden cap is put on the sash bar which holds the glass in place. If desired to have the glass tight, the abutting edges may be just touched with white lead before being put together. This makes a very satisfactory roof.

REVIEW QUESTIONS

1. Discuss the use and construction of a cold frame.
2. Discuss the use and construction of a hotbed.
3. Discuss the use and construction of a fire hotbed.
4. Discuss the use and construction of a greenhouse.
5. How should the ventilation and temperature be regulated for plants grown under glass?
6. How should plants be watered?
7. What kind of soil is best for plants growing under glass?
8. What is a good method of starting plants in a greenhouse?
9. What may be substituted for glass on hotbed sashes?
10. Name ten important things to be remembered in building glass houses for plants.

CHAPTER VII

INSECTS INJURIOUS TO VEGETABLES

IN this chapter only the more common insects infesting garden vegetables are mentioned. There are many others that almost yearly cause some damage to our crops and which in occasional years cause serious loss. But to discuss them would require more space than can be afforded here.

Classes.—In dealing with insect pests it is well to remember that biting insects, such as potato beetles and blister beetles, are generally most surely destroyed by arsenical poisons, such as Paris green; while sucking insects, such as plant lice and chinch bugs, are not affected by them but are most readily destroyed by external applications, as tobacco water and kerosene emulsion.

Natural Enemies.—We should also remember that in our war upon injurious insects we have the support of most of the birds and of the moles and shrews, and these should be protected as the friends of man rather than be destroyed, as is too often the case among thoughtless or ignorant people. Moles and shrews are especially useful, since they work under ground and feed largely on various insects that are difficult to destroy on account of their living in the soil. It is perhaps no exaggeration to say that the shrew (often called mole) will eat its weight of insects each day. Insects are also subject to attacks of parasites or of fungous and other diseases, which destroy them in large numbers and often in a very short time.

When insects appear in small numbers, hand picking is often a very efficient remedy, but when they become very abundant some other method of destroying them must be employed.

INSECTICIDES AND OTHER INSECT DESTROYERS

Pyrethrum is the insect powder of the stores. It is made by grinding the flowers of the pyrethrum plant, which closely resembles the common oxeye daisy. It is not poisonous to higher organized animals although very destructive to many kinds of insects. It is frequently adulterated and can seldom be obtained of good quality. It also deteriorates very quickly when exposed to the air. On these accounts it is often difficult to get satisfactory results from powder obtained at the stores. When used it should be diluted with about five times its bulk of flour, with which it should be kept in a tight vessel for at least twenty-four hours before using, in order to get best results. When thus confined the flour takes up the poisonous principle of the pyrethrum. It should always be kept in an air-tight receptacle.

Paris green is a refuse product composed of arsenious acid and copper and is probably as safe as any arsenic compound. It is only very slightly soluble in water, and is used with water at the rate of one pound to one hundred or more gallons of water; it is also used mixed with dry substances, at the rate of one pound to fifty pounds of flour or one hundred pounds of land plaster, road dust or sifted coal ashes. In using it with water the addition of an equal amount of milk of lime often prevents injury to leaves. The mixture should be constantly agitated to insure applying a mixture of even strength.

Tobacco is very useful for destroying some kinds of insects in the garden and greenhouse. It is especially effective against plant lice and soft-skinned hairless caterpillars. Where smoke from it can be confined around the plants, as in greenhouses and hotbeds, it is common to use it in a smudge, but when thus used it should be kept from blazing. It is also used in powdered form to keep off some insects. A more common and effective way of using it is as a decoction in water at the rate of one pound of tobacco stems, leaves, or dust to two gallons of water. The tobacco should be boiled in the water for twenty minutes. When cold the decoction should be applied undiluted, using a syringe, spray, or other means of application. The decoction will not keep more than a few days without spoiling. Tobacco is an excellent fertilizer as well as insecticide. Many forms of tobacco preparations are on the market, among which nicofume and nicotocide are used for aphis of various kinds.

Arsenate of Lead.—Arsenate of lead is the best arsenious poison to apply, because it does not hurt the foliage of plants, stays in suspension longer, and adheres to foliage better, sometimes remaining on the foliage in poisonous amounts from June to late in the fall.

The usual amount applied is three pounds to fifty gallons of water. Five pounds to fifty gallons are sometimes used for insects hard to poison. It comes in a paste form which is easily mixed with water. Arsenate of lead may often be applied to advantage with Bordeaux mixture or other fungicides.

Hellebore.—White hellebore is a common insecticide for chewing insects. It is not a lasting poison, since it loses its poisonous quality soon after exposure to the air. It is used for cabbage and currant worms. Hellebore may be dusted on when the plants are moist, or applied in water at the rate of from one to two ounces of powder to two gallons of water.

"Sticker."—Difficulty is found sometimes in making poisons stay on a plant as desired. This is overcome by boiling together two pounds of resin, one pound of sal soda, and one gallon of water for an hour or an hour and a half and adding to every one hundred gallons of spray material.

Kerosene emulsion is a valuble insecticide. It kills by contact and is of greatest importance for destroying sucking insects, such as lice, scale insects and soft caterpillars, but also kills many biting insects. It is made as follows:—

Kerosene oil, 2 gallons, 67 per cent; common soap, or whale oil soap, ½ pound. 33 per cent.

Two pounds of soft soap may be used in place of the soap recommended.

Dissolve the soap over a brisk fire, remove, and add the kerosene while the water is hot. Churn the mixture or stir rapidly until a cream-like emulsion is secured. If well made the kerosene will not separate but, on cooling, the emulsion will thicken into a jelly-like paste that adheres without oiliness to the surface of glass. Soft water will give far better results than hard water for making kerosene emulsion, and soap that is made with potash or soda lye, such as home-made soap, is far better than most of the soaps of the stores, which do not emulsify easily. For plant lice, dilute the emulsion recommended with from twenty to twenty-five parts of cold water. The strength of the application will necessarily depend on the insects to which it is to be applied. For such insects as soft-skinned caterpillars the emulsion should be diluted with not more than ten parts of water.

Kerosene and milk emulsion may be used as follows:—

Kerosene,........................ 2 gallons
Sour milk......................... 1 gallon

These readily form an emulsion when thoroughly churned together. It should be used the same as other soap and kerosene emulsions mentioned. Sweet milk does not emulsify readily, but if a little sour or even if very sour it unites easily with the kerosene. This is the best emulsion where the water is very hard.

Carbon bisulphide is a very inflammable material which has a disagreeable odor and which readily vaporizes. It should be handled with the same precaution as gasoline, which resembles it in appearance. The fumes that it gives off are very heavy and are poisonous to animal life when confined with it. On account of these properties it is used for killing weevils in grain or peas, beans, and other seeds, and for killing gophers, mice, or other creatures in their holes. The method of using it for grain weevils is to fill a barrel or other tight receptacle nearly full of seed; then sprinkle on an ounce of the liquid for each one hundred pounds of seed and cover the vessel tightly for several hours. It does not hurt the grain, which is just as good and looks as nice as ever after being treated. The germinating qualities of the seed are not injured by this treatment. When used for killing moles, gophers, and mice, the material should be put on cotton or other absorbent and placed in their holes, which should then be closed with earth.

Catching Insects by Light at Night.—By suspending a lantern at night over a tub of water having its surface coated with kerosene, many night-flying insects can be destroyed. Among those that can be caught in this way are cut-worm moths, the clicking beetle (which is the mature form of the wire worm), and the May beetle (which is the mature form of the white grub). When these insects become especially abundant, this method of catching them is worthy of trial. The objections to it are: (1) It is the larvae and not the flying form of these insects that do serious injury. (2) Few persons are so far sighted that they can be persuaded to attack insect enemies until they are suffering from their ravages, and the benefits of this method will not be felt until perhaps the following year. (3) The observations of Dr. Otto Lugger show that insects have generally laid their eggs before they fly much, and only the male insects of some species fly, and the females are nearly or quite wingless. It is obvious that in such cases catching the flying insects will do little if any good.

Applications of Insecticides.—In applying insecticides it is generally important to begin their use as soon as the insects appear and not wait until the plants have been weakened and set back by their attacks. There are many and various machines for distributing insecticides. The machine best adapted to this purpose will depend much on the insecticide used and the extent of the operations contemplated. For applying liquid compounds some of the many forms of spray pumps will be found best. For the small garden where there is a variety of crops grown, perhaps what is known as the knapsack spray pump is as convenient as any general-purpose machine. Where potatoes are grown on a large scale some special spray pump that can be geared to the wheels of a wagon may often be the best to use. Where insecticides are used in powder form, it is a good plan to scatter them on the plants through a coarse linen bag or fine wire cloth. When such material needs to be ejected with force, a fan or bellows may be used. It is always best to use poisons in a liquid form when practicable, since it is the most economical and effective method of applying them. No insecticide should ever be used in a large way until it has been tried on a small scale to see what its effect will be on the crop to be treated, since plants may be more susceptible at one time than another to applications of this nature.

COMMON GARDEN INSECTS AND METHODS OF DESTROYING THEM

The Colorado Potato Beetle (*Doryphora decemlineata*).—The Colorado potato beetle is so common and so well known by every farmer and gardener in this country that it needs no description here. It came originally from the Rocky Mountain region, where it fed on the native sandbur (*Solanum rostratum*), which is closely allied to the potato; but when this insect came to know the cultivated potato it preferred it to its original food and has since become a very dangerous pest to this vegetable. The orange-colored eggs, varying in number from a dozen to fifty, are generally laid on the under side of the potato leaf. They hatch in about a week into sluggish larvae, which feed upon the leaves, never leaving a plant until all the leaves are gone. They feed to some extent upon tomatoes and eggplants. When fully developed the larvae descend to the ground, where they pupate, emerging as perfect beetles. There are three broods each season. The beetles winter over in potato fields.

Fig. 43. The Colorado potato beetle in all stages.

Remedies.—The number of these pests varies greatly from year to year. The chief remedies are arsenical poisons applied to the foliage. For this purpose Paris green is mostly used, and arsenic of lead to some extent. The method of applying them varies much. The quantity of Paris green to use is one pound per acre for each application in from twenty-five to seventy-five gallons of water or Bordeaux mixture. The agitation must be thorough, to prevent the Paris green from settling. It is a good plan to add freshly slaked lime to the Paris green mixture at the rate of one to two pounds of stone lime to one pound of Paris green.

Arsenate of lead may be used instead of Paris green. It has the advantage of sticking much better in rainy weather and of being less liable to burn the foliage. It must be used at the rate of five or six pounds per acre for each application, in from twenty-five to seventy-five gallons of water or Bordeaux mixture. It usually comes on the market in a paste form. It is more costly to use than Paris green. Liquid mixtures may be applied with a watering pot or brush broom, but a spray pump is most economical, and on large areas a large one- or two-horse outfit is necessary.

Paris green may be safely applied when mixed with twenty-five times its bulk of flour, sifted ashes, or road dust, or mixed with twenty-five pounds of land plaster. Other poisons than the above should be used with caution.

It is very important to apply the poison as soon as the young larvae can be seen on the leaves, for they are more easily killed at this stage, requiring about a third less poison than later on. Plants injured when young are severely set back.

Imported and Native Cabbage Worms (Pieris sp.).—The imported cabbage worm resembles our native species, and both of them are very destructive to cabbage, turnip, cauliflower, and similar vegetables, and to such flowering plants as mignonette, stocks, and nasturtiums. They feed on the leaves and will often destroy the cabbage crop unless preventive measures are taken. The worms of the imported species are green in color, while our native species are bluish with yellow stripes. The butterflies of both species are much alike. They are generally white with indefinite black marks above and yellow or green markings on the under side, and are commonly seen flitting over fields of

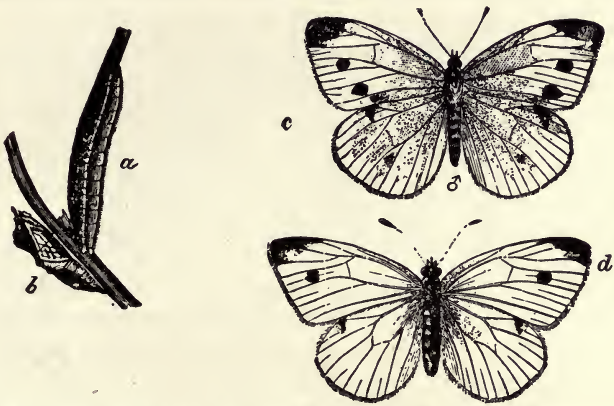

Fig. 44. The cabbage worm; *a*, larva; *b*, chrysalis; *c*, adult male; *d*, adult female.

cabbage or of other of its food plants during the day time. The full-grown caterpillar is about an inch and a half long. The winter is passed in the chrysalis stage hidden away in sheltered places, and from these the adult butterfly emerges in the spring and lays her eggs on the under side of the leaves, where they hatch in about one week. There are several broods in a season.

Remedies.—Pyrethrum powder mixed with five times its bulk of flour and dusted into the cabbage just at night-fall is a good remedy. The flour should be mixed with the pyrethrum overnight. In a small way hand picking may be successfully resorted to. If the worms are troublesome where cabbage is grown on a large scale it is customary to use arsenical poison mixed with flour, as recommended for the potato bug. The poison cannot be applied in water, as it will not stick to the leaves. These poisons, it is evident to anyone, can be safely applied before the plants commence to head, and recent careful trials and analyses of cabbage thus treated with Paris green show there is very little danger in using it at any stage of the plants. It is the simplest of remedies and effective, yet not dangerous. There are parasites that attack and kill the worms and chrysalises, and Dr. Lugger has shown clearly that they sometimes may be destroyed very rapidly by disease as well as by insect parasites. It is not uncommon to have nearly all these worms die in the latter part of any season from one or both of these causes.

Cabbage Plusia (*Plusia brassicae*).—The cabbage plusia eats irregular holes in the leaves, and burrows into the heads of the cabbage. The parent insect is a moth of a dark-gray color distinguished by a silver mark on each wing. The eggs are laid on the upper surface of the leaves singly or in clusters. They soon hatch into pale-green translucent worms, marked with paler longitudinal stripes on the back and sides. When full grown these worms are about two inches long. They resemble span worms in their mode of locomotion, hence are easily distinguished from the cabbage worm. The full-grown caterpillar spins a cocoon, generally on the under side of the cabbage leaf, in which it undergoes its changes. The insect winters over in the pupal state. The remedies for this pest are the same as those recommended for cabbage worms, and it is also subject to diseases and parasites.

Wire Worms or Drill Worms (Elater).—Wire worms cause damage by boring into potatoes and some seeds in the ground. They are the larvae of a snapping or clicking beetle, so called from the ease with which, if laid on their backs, they spring into the air with a clicking noise. The larvae are slender wirelike worms having a glassy, tough skin of a yellowish or brownish color. The larval stage lasts for two and possibly five years; it is therefore no small job to

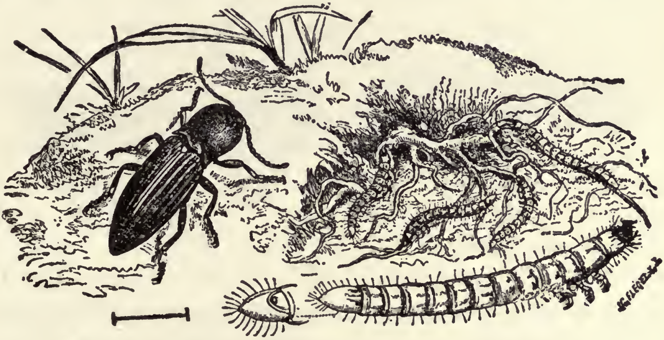

Fig. 45. Snapping beetle, or wire worm, with larvae.

clear a piece of land badly infested with the pest. Naturally, wire worms live in grass land where the harm they do is not apparent, but when such land is planted to corn or potatoes and the worms are thus deprived of their natural food they may become very troublesome.

Remedies.—Late fall plowing is desirable for land infested with wire worms, since it exposes and thus kills all that are ready to pupate. By clean summer fallowing the land one season the worms are starved out, if no plants whatever are permitted to grow on it.

Cut-worms (Agrotis sp.).—Cut-worms often cause serious injury by eating vegetable plants. They are generally most injurious while the plants are small, when they often bite off young cabbage, bean, corn, or other plants close to or just under the ground and thus destroy them. Their work is most perceptible in the spring, on account of the small amount of growing vegetation at that time, yet they also work in the autumn. True cut-worms are the larvae of several night-flying moths which appear late in summer. The female deposits her eggs late in the summer. These soon hatch into worms which enter the ground and live near the surface on the tender roots of grass and other plants until the

Fig. 46. Cut-worm and moth.

approach of cold weather. They then descend deeper into the ground and remain torpid until spring, when they come to the surface and again commence their depredations. Cut-worms, when full grown, are from one and a quarter to one and three-quarter inches long and rather large in diameter as compared with the length. Their skin is of some dull color, smooth, often with dull stripes and bands.

Remedies.—Cut-worms are most injurious in sod land or land on which weeds have been permitted to grow in autumn, or in land adjacent thereto. They are not likely to winter over on any land that is kept free from weeds and grass in autumn, since there is no food for them in such places. The worms feed almost entirely by night and hide during the day time under clods or just under the surface of the ground near where they have been working. In a small way they may be dug out and destroyed, but in fields and on a large scale this is impossible, and a good remedy is to scatter bait of poisoned clover through the fields. This is easily prepared by dipping clover into Paris green and water. A dough made of bran and Paris green sprinkled about the plants will often be found very satisfactory in destroying cut-worms, and sometimes will work even better than clover for this purpose. Where cut-worms are abundant a larger amount than usual of seed should be planted that a good stand may be secured even if the worms do get some of it.

When plants such as cabbage, cauliflower, and tomatoes are planted out, it is a good plan to wrap the plants with pieces of stout paper extending about an inch below and three inches above the ground. When boxes or tomato cans are set around plants for shade, they afford a good protection from this pest. Protection from cut-worms to hills of melons, cucumbers, and similar plants may be given by pieces of pasteboard or tin. These should be cut about three inches wide and sufficiently long to encircle the hill. They should be set about an inch deep in the ground. Spraying the plants with Paris green is a good remedy. The moths of cut-worms, as well as such insects as adult wire worms and grub worms, may be killed at night by means of a lantern suspended over a tub of water having a little kerosene on its surface. This should be done late in the summer when the moths of cut-worms are abundant.

Striped Cucumber Beetle (*Diabrotica vittata*).—This little beetle attacks squashes, cucumbers, and melons when they are young. By eating the foliage and tender stems they may cause the death of the young plants. When abundant it is a very difficult pest to combat. It appears in the spring at just about the time the young squash plants are out of the ground, having wintered over in brushpiles or other places affording protection. The beetle lays its eggs on the roots of corn, where the young do considerable damage. These worms are full grown in about one month from hatching. They then leave the roots, make a little cavity in the earth near by, and undergo their changes. The insects spend the winter in the beetle stage. The beetle is about a quarter of an inch long and is striped with yellow and black. It is very quick in its movements but does not fly much except in the middle of the day.

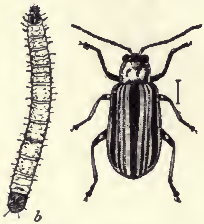

Fig. 47. Striped cucumber beetle and larva.

Remedies.—An extra amount of seed should be sown so as to secure a good stand and still allow some for the beetles. Dusting the vines, stems, and leaves when they are moist, with air-slaked lime, road dust, or similar material containing a little Paris green or other poison, is quite a protection, and if persistently followed up after every rain will generally prevent serious loss. But care should be taken to put the dust on the stems as well as the leaves. Paris green and water is also a good

Fig. 48. Cheesecloth screen for protecting young cucumber, squash, and melon vines from the striped beetle.

remedy and is applied the same as for the potato beetle. Tobacco dust is also an excellent preventative used in this way. Some gardeners having quite extensive plantings and many who are working in a small way prefer to cover each hill with a box or frame covered with cheesecloth. In this case, the edges of the box or frame should be sunk an inch or so in the ground to keep out the bugs. Frames for this purpose are readily made of barrel hoops cut in halves and fastened together, or of three slender sticks, forming a sort of tent. This method allows the light and air to circulate freely around the plants, while at the same time they are perfectly protected and at slight cost.

Fig. 49. The May beetle and larva, or white grub.

White Grub or May Beetles (*Lachnosterna fusca*). — The insect known as the white grub is the larval stage of the May beetle. It lives in the soil, where it feeds on the roots of plants. The mature insect is a dark-brown beetle, often nearly black, with breast covered with yellowish hairs. The body is three-fourths of an inch long and about a half inch in diameter. They fly at night and are well known insects of the spring of the year. As beetles they feed on the leaves of various plants. The females lay their eggs among the grass roots in a ball of earth. These hatch in about a month, and the grubs begin to feed on the roots near by. They require two or three years' changes, and emerge in the spring of the third or fourth year as the beetles described.

Remedies.—The grubs are eaten by birds, moles, and skunks. They are not apt to be abundant in any but grass land recently broken up. They are exceedingly hard to destroy on account of their remaining so long in the soil. When young plants are seen to be wilting from the effects of the grub, they may sometimes be taken up, the grub removed, and the plant reset. When lawns or other grass lands are badly affected they should be broken up and grown in some cultivated crop for two years. The beetles should be trapped when they become abundant, as recommended for cut-worm moths. Such animals as moles and shrews should generally be permitted or even encouraged in our lawns and gardens and the little damage they generally do suffered patiently, since they are among our best friends and destroy immense numbers of white grubs and other insects that live in the ground and are difficult for us to reach. They are seldom abundant except where insects are numerous.

Maggots (Anthomyia sp.).—They are often destructive to the seed or roots of a variety of plants, including onions, cabbage, cauliflower, and similar plants; they also attack the seed of corn, peas, beans, and other vegetables in some seasons.

Life History.—The maggot here referred to is the larva of a fly somewhat resembling the house fly, but brown in color. The eggs are laid in or near the surface of the ground, generally on the food plants, and hatch out in about two weeks into maggots, that commence to feed at once and finally become one-half inch long; these change in two weeks more to flies. This insect winters over in the pupa state in the ground.

Remedies.—When this insect attacks onions the infested plants turn yellow and look sickly, and all of them should be pulled and destroyed. The same treatment should be given to any onions that may be found infested at harvest time. When onion land becomes badly infested with this pest, crop rotation should be practiced and no onions should be raised near it for a year or two. When beans, corn, and peas are affected the seed should be treated with a very thin coating of coal tar and afterwards rolled in plaster or other dust. The coal tar may be applied as follows: Spread the grain out in a warm room on the floor about six inches deep and wet it with warm water; sprinkle on a very little warm coal tar (about one tablespoonful to one-half bushel) until each grain is coated; then roll it in plaster to dry it off. If this is carefully done the grains will not stick together and may be planted by any planter. This treatment also prevents crows, gophers, and squirrels from pulling newly planted corn.

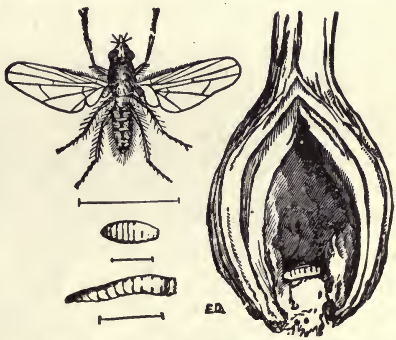

Fig. 50. The common onion maggot in various stages.

When it attacks cabbage, cauliflower, and similar plants it may be destroyed by kerosene emulsion, since the maggots work on the stem and roots of the plant near the surface of the ground and such an application would be practicable in this case; while in the case of many other crops, such as onions, beans, etc., it might be quite out of the question on account of the large number of plants that would have to be treated to make it effectual. In the case of cabbage, however, it may be prevented from entering by inserting the plant through a small piece of tarred paper that is allowed to remain flat on the surface of the ground.

Cabbage Flea Beetle (Halticus sp.).—There are several insects closely resembling one another and known as cabbage flea beetles that feed on the surface of the leaves of cabbage, turnips, radish, cauliflower, etc., and various wild plants. They are very injurious to the very young plants if allowed to have their way, but when the plants are nicely started they do not seem to be seriously affected by this pest. These beetles are very small and move very quickly. The adult insect is black or nearly so; some of them lay their

Fig. 51. Different species of flea beetles with their larvae.

eggs near the roots of the food plants, where the larvae do some damage; in other cases the eggs are laid on the underside of the leaves and the larvae mine into them and live between the upper and lower surfaces. But their chief damage is as beetles, in which form they pass the winter. One species of flea beetle is sometimes destructive to potato vines.

Remedies.—Since these are biting insects they are readily killed by Paris green in the usual proportions. If the plants are kept dusted with air-slaked lime or plaster they are measurably protected from this insect. But the latter applications are greatly improved by adding a little poison to them.

Leaf Lice or Aphides (Aphis sp.).—The various kinds of leaf lice, otherwise called aphides, that live on plants have very much the same general habits. They are all sucking insects and increase with great rapidity when their food plants are abundant. They generally winter over in the egg state. The summer broods are often brought forth without the intervention of the egg state. Kerosene emulsion and tobacco water are the useful remedies, but hot water and pyrethrum will also destroy them. Leaf lice are eaten by the larvae of lady bugs, and they are also subject to attacks of parasites. When the lice are coated with a meal-like covering that sheds water and prevents their being wet by insecticides, they should first be sprayed with strong soapsuds to remove the mealy covering and then the insecticide may be applied successfully.

Cabbage Lice or Aphides (*Aphis brassicae*).—These are light brown insects covered with a floury substance. They attack turnips, cauliflower, rutabagas, and similar plants, as well as the cabbage. They work generally on the lower side of the leaves, where they collect most abundantly. They are most numerous in dry seasons. The remedies for them are those given under the general head of leaf lice, but in addition to those it is a good plan to burn or compost all the old cabbage leaves and stumps, since the eggs winter over attached to them.

Sweet Corn Moth or Tassel Worm (*Heliophila unipucta*).—This is the boll worm of the South. It eats into the green grain of the corn, but is seldom very troublesome in the North. Dr. Lugger thinks that it does not winter over in the extreme Northern states, but that the moths come from the South each year. The only remedy is hand picking. It is doubtful if they will ever become very injurious in the Northern states, since they do not begin their work there until late in the season.

Parsley Worm or Celery Caterpillar (*Papilio asterias*).—This worm eats the foliage of celery, carrot, parsley, and allied plants, but is not very often injurious. The mature insect is a beautiful large black butterfly having yellow and blue spots on its wings. The eggs are laid on the foliage and hatch into small caterpillars less than one-tenth of an inch long, which when full grown are one and a half inches long. It has bright yellow markings. The remedy is to hand pick the worms, which are seldom abundant.

Chinch Bugs (*Blissus leucopteris*).—The chinch bug does not trouble any of our garden products except corn, but is sometimes very injurious to this vegetable and may kill it in a very few days if neglected. This is a sucking insect that winters over in the adult state under leaves and in dry protected places generally. When full grown it is about one-seventh of an inch long with white upper wings having two well-defined black spots on them. When crushed they have an offensive bedbug-like odor. This insect is not affected by cold weather, but succumbs quickly to moisture. The female deposits her eggs near the ground on the stems or roots of wheat, oats, grasses, etc.

Fig. 52. The chinch bug (enlarged).

Remedies.—The burning of rubbish accumulations along headlands, fences, etc., in the winter or early spring in infested localities will destroy many. They always infest the small grains before they do corn.

While these insects have wings they use them but little in their migration in summer, but they travel on foot and often in great numbers. Taking advantage of these peculiarities they may be kept from corn fields by plowing deep furrows in their way, which should be turned back as soon as filled with bugs and new furrows made. Fences of boards six inches high with the upper edge kept covered with tar will keep them out, but holes in the ground should be made at intervals along the line of the boards, which when full of bugs should be filled in with earth, and new holes made. A dusty headland or road is very difficult for them to go through. If they finally reach the corn they will readily succumb to kerosene emulsion. Much is being done to rid the grain fields of this pest by infecting the bugs with disease. This works most rapidly in moist weather, but other remedies should not be put aside for this one.

Bean and Pea Weevil (Bruchus sp.).—The insects known as weevils are quite common in some sections. They

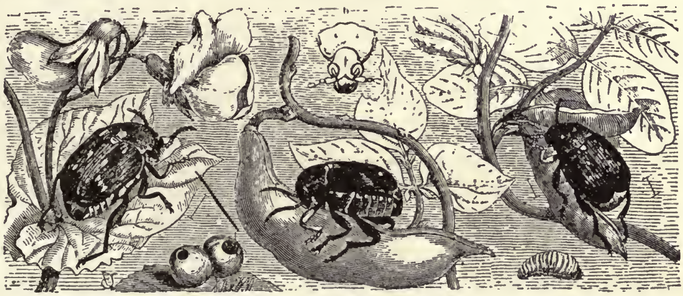

Fig. 53. The bean and pea weevil; *a*, peas from which weevils have emerged; *c*, larva.

work in the seed of beans and peas. The adult insects are small beetles which lay their eggs in the flowers, where they soon hatch and the young larvae eat their way into the immature seeds. The hole by which the larva enters the seed grows completely over, so that the seed appears unimpaired externally. In the seed the larva does not touch the germ, though it may eat up a large part of the starch. The larva undergoes its changes in the seed, completing which the beetle emerges through quite a large hole in the shell of the seed. While seed that is infested may germinate, it forms only weak plants that are very sure to fail to mature a full crop. Similar insects also attack corn. There is another species that breeds in stored grain, peas, and beans, etc., but it is not common.

Remedies.—These insects are generally somewhat local in range. Whenever any locality is infested the date of planting should be delayed two weeks, by which means the beetles fail to find the crop ready when they are ready to lay their eggs. The trouble generally comes from sowing infested seeds. These may be separated out by throwing the seed into water, when the good will sink, but those infested will float. Another method is to treat the seed with carbon bisulphide, as recommended under that head. If the seed is kept over two years the beetles will have come out. The species that breeds in the grain is most easily destroyed and kept out of the seed by using bisulphide of carbon, as recommended.

Squash Vine Borer (*Aegeria cucurbitae*).—The squash vine borer is the larva of a moth. The eggs are laid on the stems of the young plants near the roots of cucumber, squash, and melon vines. The larvae on hatching burrow into the stem and follow along the center, which causes the plants to wilt and finally to die. The full-grown borer measures about one inch in length and has a whitish body with a brown head. The borers leave the stem the latter part of the summer and winter over near the surface of the ground in cocoons composed partly of earth. The moth emerges the following spring.

Remedies.—This insect is not yet found in this section but is common in the Eastern states, and where it is found, all withered or dead vines should be destroyed. When

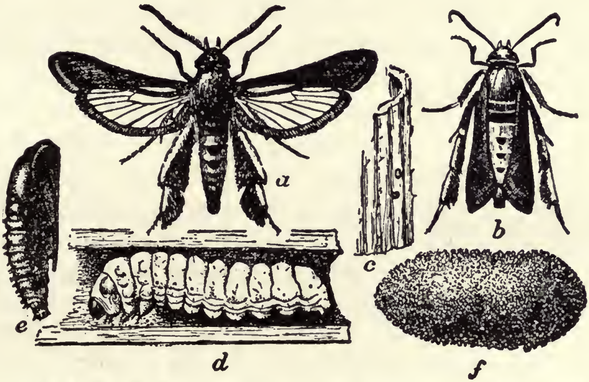

Fig. 54. Squash vine borer; *a*, male moth; *b*, female, with wings folded naturally; *c*, eggs; *d*, full-grown larva; *e*, pupa; *f*, pupa cell. (Chittenden.)

vines have only commenced to wilt the borer may often be cut out, when the vine will recover. It is also a good plan to cover several of the lower joints of squash vines with earth to encourage the formation of extra sets of roots at these places.

The Squash Bug (*Anasa tristis*).—This insect makes its appearance the latter part of June or the first of July. The females deposit their brownish-yellow eggs in small patches on the under side of the leaves. These hatch into nymphs that suck the sap of the leaves, often seriously injuring them. The full-grown bug is a little over one-half inch long and is of a rusty black color above and yellowish beneath. It emits a disagreeable odor when touched.

Fig. 55. The common squash bug—natural size. (Chittenden.)

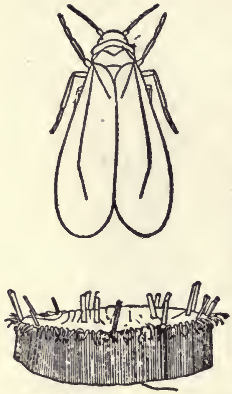

Fig. 56. Greenhouse white fly, adult and pupa—highly magnified. (Chittenden.)

They winter over in rubbish, under boards, or anywhere they can find protection.

Remedies. — Hand picking in the morning and evening, at which times the bugs are somewhat torpid, is the most practical remedy. Boards laid among the plants at night will be found to have many bugs under them in the morning, and these may be crushed or otherwise destroyed. Large numbers may be killed in this way.

REVIEW QUESTIONS

1. Name two biting and two sucking insects and remedies.
2. What is pyrethrum? Paris green? Kerosene emulsion? Tobacco? Carbon bisulphide?
3. How is each applied? Give formula for using.
4. What are objections to catching insects at night by a light?
5. How are insecticides applied?
6. Give the life history of Colorado potato beetle, and remedies.
7. Give the life history of cabbage worm, and remedies.
8. Give the life history of cabbage plusia, and remedies.
9. Give the life history of wire worms, and remedies.
10. Give the life history of cut-worms, and remedies.
11. Give the life history of striped cucumber beetle, and remedies.
12. Give the life history of white grub, and remedies.
13. Give the life history of maggots, and remedies.
14. Give the life history of cabbage flea beetle, and remedies.
15. Give the life history of leaf lice, and remedies.
16. Give the life history of cabbage lice, and remedies.
17. Give the life history of parsley worm, and remedies.
18. Give the life history of chinch bug, and remedies.
19. Give the life history of bean-pea weevil, and remedies.
20. Give the life history of squash vine borer, and remedies.

CHAPTER VIII

MARKETING

MARKETING is the most important phase of vegetable growing, and is the point where a great majority of growers make their failure. Many men are excellent growers, but for some reason do not put their produce on the market in attractive packages, or else do not have it in season, or it is of poor quality. A few days' tardiness in putting some produce on the market may mean a loss of profit on it. A good, honest, attractive pack is always a splendid means of holding the steady trade of a customer, and this is what should always be aimed at.

Grading.—It pays to grade vegetables as well as fruits. As a rule fifty bushels of tomatoes well graded to size, shape, color, etc., will sell more quickly and for a better price than fifty bushels ungraded. Neater packages may be made up of vegetables well graded than where they are mixed, and attractiveness is the great factor in selling any produce.

Cleanliness.—Cleanliness is an important factor in selling. Some vegetables, such as cucumbers, cabbage, etc., may be packed in the field without washing; others, such as radishes, lettuce, celery, and the root crops, are often washed in the packing shed. This washing not only takes off the dirt but brightens and freshens the vegetables Asparagus, celery, and rhubarb are often stood on end in a shallow pan of water to prevent their wilting. Some vegetables, as the root crops, often require careful scrubbing to make them clean. Eggplants, tomatoes, and melons may be wiped off with a damp cloth. Clean, new packages should always be used.

Packages.—The package is an important factor in marketing and one that is changing frequently. Different vegetables, of course, require different types of package. Markets vary in package requirements. Some use a bushel box, others a bushel basket, and still others sell the product by weight. Some markets require produce to be put up in small packages, others in large ones. The market should be studied to determine the best package. Packages should be chosen that are best adapted to showing the vegetable in the most attractive manner, that are easy to handle, and that protect the fruit to the best advantage.

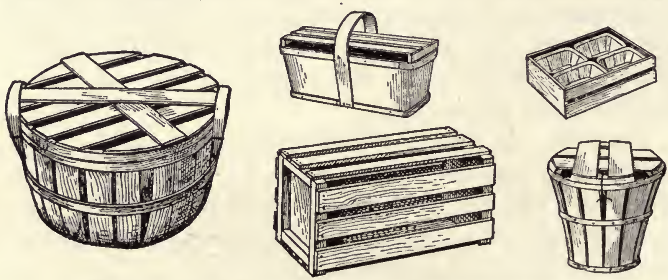

Fig. 57. Types of packages used in market gardening.

Cheapness of package is not so important as that it be attractive. A cheap package often turns out to be expensive because it does not permit of proper exhibition of the vegetable, or perhaps it is too easily broken and so does not protect it in handling. A package that can be used for local sales may not be of any value for long shipments on account of its being too easily broken. The size of package must be adapted to the vegetable and to the special market requirements, as a rule.

Selling.—There are three main channels for selling vegetables: (1) the consumer direct, (2) the retailer, and (3) the wholesaler.

Selling direct to the consumer takes more time away from the garden and is distasteful to many growers. Others in small towns are able to work up a good paying business in this way. In order to hold customers, a large variety of vegetables must be grown and great pains taken to have only the best quality on sale at all times. H. B. Fullerton, of Long Island, has developed a package which he calls the

Fig. 58. The Long Island home hamper. (Photo courtesy H. B. Fullerton.)

home hamper. This is filled with a seasonable variety of vegetables and expressed directly to the consumer at stated times as may be agreed on. This gives the customers the variety of vegetables they may desire and enables them to obtain them fresh. A cut of this hamper is shown in Fig. 58. A certain priced hamper is usually agreed on for the season or for the year.

Many gardeners may sell direct to retailers, such as the grocers, either from the market or from their homes. This is very satisfactory to growers because it does not take much time away from the farm.

The third method of selling is to the wholesaler, either delivering to him direct or shipping from the country. This is, of course, the method that the large trucker or the grower of special crops must follow very largely. Many growers grow special crops, especially for certain wholesalers. This method has the advantage of taking a small amount of time from the farm and does away with the bother of retailing, although not as high prices are realized. It is a favorite method of many growers.

Advertising.—Growers who retail, or sell direct to the consumer, often fail to realize the value of advertising their business. A little judicious advertising in the local papers often gives good returns. If the grower is on a well traveled highway near a large city, a bulletin board at the entrance of the farm, listing produce for sale, often brings customers, although there is usually too much bother attached to this method of selling to make it profitable.

Co-operative Associations.—In the trucking districts of the country co-operative associations have proven of value. These associations can employ men to do the selling of produce and to purchase tools, packages, etc., thus relieving the grower of much work that he is often not qualified to perform. The association is able to control the grading and the marketing of produce to much better advantage than can individuals. It gives a chance to open markets at a distance because there is a certainty of being able to supply vegetables in large quantities and over a longer season than one individual could. The selling can be done at much less expense than if each grower marketed his own produce.

CHAPTER IX

GARDEN VEGETABLES

CLASSIFICATION OF VEGETABLES

Vegetables may be classified in many ways, but perhaps the most helpful way is to divide them according to the conditions under which they grow best, into (1) warm- and (2) cold-climate vegetables.

(1) **Among warm-climate vegetables** (often called tropical) we have tomato, corn, beans, pepper, eggplant, cucumber, muskmelon, watermelon, squash, pumpkin, and okra. These plants all require hot weather for their growth, are severely injured by the first hard frost, and should not be planted in open ground until warm weather is assured. They are generally at their best on a warm southern exposure and in soil having a little sand in its composition. These plants are all natives of hot climates and will not survive long in cold climates when left to themselves.

(2) **Among cold-climate vegetables** we have practically all those commonly grown not mentioned under (1), such as asparagus, rhubarb, horseradish, salsify, and parsnip, which stand our severest winters without injury; and those that are less hardy, such as onion, leek, pea, beet, spinach, cabbage, Brussels sprouts, cauliflower, cress, kale, kohl-rabi, radish, rutabaga, turnip, carrot, parsley, celery, celariac, lettuce, endive, potato, strawberry, tomato, and others. These all grow well at a cool temperature and most of them will stand some frost without injury. They may be divided into those with tops that are frost-hardy and that are frost-tender, as follows:—

By frost-tender vegetables is meant those whose tops are injured by a light frost; such as, potato, asparagus, strawberry, tomato, and of course all the tropical plants mentioned under (1). Some plants, like asparagus and our native oak tree, may have foliage that is very susceptible to frost but are hardy in winter.

By frost-hardy vegetables is meant those having foliage that is not injured by light frost, among which are horse-radish, rhubarb, onion, leek, garlic, pea, spinach, beet, cabbage, Brussels sprouts, cauliflower, cress, kale, kohl-rabi, radish, rutabaga, turnip, carrot, parsley, celery, lettuce, endive, and most of the garden herbs.

Botanical Classification.—All plants may be divided into families, each of which has its distinguishing features. Our garden vegetables and herbs belong to at least seventeen families. The special features of each of which will be found with the cultural directions for the plants grouped under them, but for convenience a list is here given of all the vegetables referred to herein, arranged under their proper family names:—

The Fungi Group or Family,—mushroom, or toadstool.

The Grass Family (Gramineae),—corn.

The Lily Family (Liliaceae),—asparagus, onion, leek, garlic.

The Buckwheat Family (Polygonaceae),—rhubarb, or pieplant.

The Goosefoot Family (Chenopodiaceae),—beet, Swiss chard, and spinach.

The Cabbage Family (Cruciferae),—cabbage, cauliflower, radish, rutabaga, turnip, Brussels sprouts, kale, kohl-rabi, horseradish, cress and water cress.

The Clover Family (Leguminosae),—bean and pea.

The Mallow Family (Malvaceae),—okra.

The Parsnip Family (Umbelliferae),—parsnip, parsley, carrot, celery, celariac, caraway, dill, anise, coriander, and fennel.

The Morning Glory Family (Convolvulaceae),—sweet potato.

The Mint Family (Labiatae),—sweet basil, lavender, balm, spearmint, peppermint, summer savory, winter savory, sweet marjoram, thyme, sage, and catnip.

The Potato Family (Solanaceae),—tomato, potato, egg-plant, pepper, and strawberry tomato.

The Martynia Family (Martiniaceae),—martynia.

The Gourd Family (Cucurbitaceae),—cucumber, squash, muskmelon, watermelon, pumpkin, and gourd.

The Sunflower Family (Compositae),—lettuce, salsify, endive, and dandelion.

The Rue Family (Rutaceae),—rue.

The Borage Family (Boraginaceae),—borage.

THE FUNGI

The Fungi group includes a large number of flowerless plants that are propagated by division and by spores. Besides the cultivated and wild mushrooms, which are discussed below, this group includes some that are poisonous, although they form but a small proportion of the whole number of species that are apt to be taken for edible kinds. The wheat rusts, mildews, grain smuts, and other similar diseases also come in under this head. The spores (seed bodies) are distributed in various ways, but very commonly by their becoming light and powdery and being blown about by the wind, as in the case of the common puffball and corn smut. There is no sure way of telling the poisonous mushroom from the edible kinds, but most of the species have been studied and their value for food is well known.

MUSHROOMS (*Agaricus campestris*)

There are many edible wild mushrooms, and they differ in no particular from the so-called toadstools, but the species named above is the kind commonly cultivated. The part eaten is really the fruit-bearing portion and not, as many suppose, the plant itself. The true plant is the white network of fibers that grow in the soil, and it is this part that is used in propagating them.

Culture.—The cultivation of the mushroom is often attended with uncertainty. It is, however, being grown on an increasingly larger scale, and the demand for it constantly increases. The conditions essential to success in growing it are a rich soil and a steady temperature of from 50° to 75° F. It is for the purpose of securing this latter requisite that cellars and old caves are often utilized in its culture, as light is not necessary. Horse manure is a practically indispensable material for the growth of mushrooms. If possible, it should be from animals fed on rich, nitrogenous food and be as free from strawy litter as it can be obtained. This should be thoroughly mixed with a fourth or fifth part of good garden soil and is then ready to go into the beds. Care should be taken that the beds are in a well-drained, damp place. They may be of any size or shape desired but should be about ten inches deep. Some of the largest growers use tiers of shelves or boxes, each one of which is eight or ten inches deep, into which they put the soil.

Whatever the shape of the beds, the soil should be packed into them firmly and evenly and be left smooth on the outside. A thermometer should then be inserted in the center of the mass. As soon as fermentation sets in, the temperature will rise until probably over 100° F. will be indicated, and when it falls to 80° the bed is ready to receive the spawn. This may sometimes be obtained from old mushroom beds, but it is best to depend on that sold by seedsmen, as it is more certain to be free from other fungi. The operation of spawning consists in putting pieces of the spawn bricks the size of small hens' eggs in holes made about two inches deep and ten or twelve inches apart. Afterwards the holes should be filled with the soil and the surface firmed and smoothed off.

If the work has been well done and the conditions are favorable, the spawn should commence to grow in seven or eight days; at the end of that time it should be examined and any pieces that have not started should be removed and be replaced by fresh spawn. A failure in germination is indicated by the absence of white threads in the manure around the spawn. When the spawn has nicely started and begins to show itself on the surface, the bed should be covered with a layer one inch thick of fine, slightly moist soil, which should be pressed down smoothly and firmly.

In damp cellars mushroom beds do not need water, but if the surface gets dry they should be watered with tepid water from a fine rose watering pot. The mushrooms should show in from five to eight weeks, and the bed continue to yield for two or three months. The spawn bricks, as they are termed by seedsmen, are simply flat square pieces of a mixture of manure and loam into which spawn has been put and has grown until it fills the whole piece. Afterwards these bricks are dried, and form the mushroom bricks, or spawn, of commerce.

Native Mushrooms.—There are quite a number of native mushrooms that are edible, but since there are also several poisonous kinds one should be careful about trying unknown sorts. Among the edible kinds are the several sorts known as puff balls (Lycoperdon). When these first appear, they are white balls of a fleshy texture with little or no stalks; as they ripen, the flesh turns gradually to a dark brown, and finally the spores are ejected by the ball being crushed or by naturally breaking open. They are not fit to eat after the flesh begins to turn brown. The smaller sorts are most common, but the giant puff ball is occasionally met with and is often ten or more inches in diameter.

Another common native mushroom is shown in Fig. 45. It has a stem several inches high, but the top does not

Fig. 59. Native mushrooms. On the left is shown the Giant Puff Ball (*Lycoperdon giganteum*); on the right, Maned Agaric (*Coprinus comatus*) in various stages of maturity.

expand. It is one of the most delicious of all the mushroom tribe when young. It is called the Maned Agaric (*Coprinus comatus*). It grows in waste and grassy places, lawns, and meadows. The gills (layers on the under part of the head) are at first white or pink, melting into an inky, fluid-like substance when more mature.

Little attention has ever been paid in this country to growing our native species. They could undoubtedly be propagated by digging up some of the earth where they grow abundantly and mixing it with the soil where it is desired to grow them. The kinds mentioned mature in the latter part of summer and are especially abundant in old pastures or other places containing much decaying organic matter and during moist weather. If an attempt is made to grow them, it would probably be necessary to keep the ground moist all summer to secure the best results.

THE GRASS FAMILY (Order Gramineae)

The Grass Family has many well-known general characteristics. It includes many species and produces the greater part of the food of the human race either directly as seed or indirectly as meat, and yet only corn is ordinarily grown in vegetable gardens. Among the most important food plants belonging here are wheat, rye, oats, barley, rice, corn, sorghum, and sugar cane. The wild rice grows in great abundance in some portions of Minnesota and Wisconsin and was an important article of food among the Indians.

CORN (*Zea mays*)

Description.—Native of America. An annual. The male flowers are in the tassel and the female flowers on the cob. While cross-fertilization is not absolutely necessary for the production of seed, it is necessary for a good crop. The varieties of corn may be easily grouped under four classes: (1) Sweet corn, which includes varieties with soft and generally much wrinkled kernels, that are especially desirable for use in a green state on account of their being sweeter and more delicate in flavor than other kinds. (2) Flint corn, which includes field varieties having a very hard, smooth grain. (3) Dent corn, which includes field varieties rather softer in texture than the flint corn, each kernel having a depression in the end of it. (4) Pop corn, which has a kernel of flinty hardness and is used almost entirely for popping purposes. These classes will all cross together. But there are numerous varieties in each of the classes, varying from one another in height of stalk, size and color of the ear and kernel, time of ripening, and various minor particulars. The color of the grains may be white, yellow, red, or purple, but white and yellow are most common. Corn is quickly improved by judicious selection, and new varieties are frequently originated in this way.

Early Sweet Corn.—For early use the seed should be sown as soon as the ground begins to get warm in the spring. Very early planting is not desirable for the main crop, since in cold , wet weather the seed is liable to rot in the ground, or the plants may be frozen on coming up. It may, however, be desirable to plant some of the earliest kinds as soon as the weather is warm, and, slelecting the most favorable location, run the risk of failure, as the profits are correspondingly large if the crop is very early, while the expense of planting is a small matter. Early varieties may sometimes be planted in flower pots, berry boxes, etc., in a greenhouses or cold frame and transplanted to the garden when danger of frost is past.

Main Crop.—The main crop of corn should be planted from the middle to the last of May. The land can hardly be too rich for corn, and it should be in a finely pulverized condition. The seed may be planted in rows at about nine-inch intervals, with rows three to four feet apart, or in hills three to four feet apart each way, according to the growth of the plants and method of cultivation to be followed. It should be covered about two inches. If grown in hills, three or four plants should be left in a place, which means planting about six seeds to the hill. If planted in hills, they may be cultivated both ways, which is an advantage over planting in rows. In rows, however, the plants develop rather better than in hills, and it is the method preferred by many good growers, though field corn is generally planted in hills. Corn should be cultivated shallow and never deep enough to cut the roots; until it is six inches high it may be harrowed with a slant tooth harrow.

Later Plantings.—In order to have a long season of this vegetable in its best condition for table use, plantings of the very early and some good second early kind should be made at the same time; and then plantings of the second

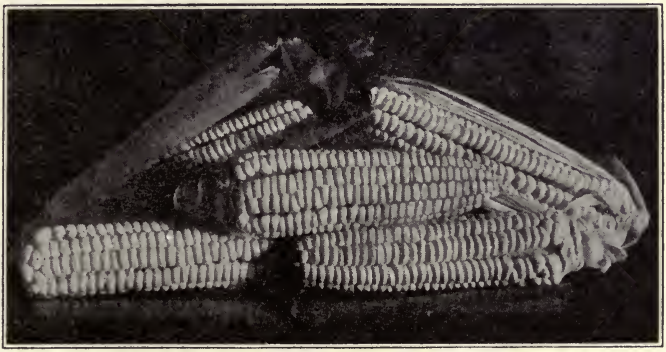

Fig. 60. Early Cory corn.

early kinds should be made once in two weeks thereafter, up to about the twentieth of June. If planted later than this there is much doubt about its getting large enough for table use before the autumn frosts set in. The very early kinds, however, may be planted in Minnesota as late as the fourth of July, with good prospects of their becoming of marketable size; but the very early varieties are small in size and not as sweet and desirable as the larger second early or late kinds, and a few varieties require the whole season in which to obtain table size. If properly planted, sweet corn may be had in a young and tender condition from the middle of July until the cold weather of autumn.

Marketing.—There is a large demand for green corn in every city and village. It is marketable as soon as the kernels are well formed and is generally sold in the husk by the dozen or by the barrel, at prices ranging on the market from five to twenty-five cents per dozen. There are many canning factories in the Northwest and many in other parts of the country that make a specialty of canning sweet corn. Grown for this purpose or for evaporating, it is a farm crop that may be made to pay very well in some locations, and extensive tracts of land are devoted to raising it. Where the crop is marketed at canning factories the fodder is left on the farm and is in admirable condition for feeding.

The canneries pay from $10 to $12 per ton for the corn in a few states. They pay by the pound for corn cut from the cob. Gross receipts for corn vary from fifty cents or one dollar to two or three hundred dollars per acre. The ears are best for table use when first picked, and quickly lose in quality after gathering; if they heat in piles or packages they are of very inferior quality.

Varieties.—Peep-O-Day, White and Red Cob Cory are early varieties. They will often mature in eight weeks. Early Minnesota, Black and White Mexican, and Golden Bantam are good second early sorts. Golden Bantam is an especially good variety for the home garden. It is sometimes difficult to sell on account of its yellow color, until the buyers have tried it. Crosby is a good early canning sort and is also a good second early for the market. For late use, but requiring a long season in which to mature, Stowell's Evergreen and Egyptian Mammoth are desirable.

They are good for canning. The Country Gentleman is a late variety for home use. The kernels are narrow and long and arranged irregularly on the cob. It has one of the smallest cobs of all varieties.

Pop corn is grown in the same way as sweet corn. For home use a very little will suffice; in some sections, however, it is raised in large quantities. It is usually marketed on the cob and is seldom salable until at least one year old. Among the best varieties are White Rice and Golden Pop.

Fig. 61. Late sweet corn.

Varieties of corn run out and change very quickly if neglected, and there is often much difference in the strains of different kinds. Those that it is desired to keep pure should be grown at least 1000 feet away from other kinds that flower at the same period. Varieties of corn of every description including all those belonging to the sweet, dent, flint, and pop corn classes, will mix together when near by each other.

Curing Seed of Sweet Corn.—The seed of the late varieties of sweet corn is difficult to cure thoroughly and is very liable to mold during the drying process, unless it is given plenty of light and air. A good way is to tie the ears in small bunches and suspend in a dry, hot, airy room after it has ripened as nearly as may be on the stalk.

Cutting off the Tassels.—It has been recommended to cut off half of the tassels from the young corn, on the ground that one-half the tassels would produce all the pollen needed by all the kernels. While some experiments have shown this to be true, many other experiments show there is little if anything to be gained by the practice.

Fig. 62. Corn smut.

Insects.—Corn is quite free from serious injury, either from insects or diseases. The most injurious insects are the cut worm and boll worm, for discussion of which see chapter on insects.

Smut (*Ustilago maydis*) is almost the only disease seriously injurious to corn. It is a fungous disease that works in almost any part of the plant, causing swellings which contain black spores. When ripe, the swellings burst and the spores are scattered to continue the disease the following year. There can be no question that gathering and destroying the bunches of spores by burning or burying them deeply in the ground would result in greatly lessening the loss from this cause. This should be done before the smut boils turn black and break open. It is, however, such an expensive remedy as to seem almost impracticable. Some experiments seem to show that soaking the seed in a solution of sulphate of copper may assist in preventing this trouble in corn as well as smut in wheat, but other experiments apparently prove the contrary, and it may be taken as a doubtful matter at the best. Practically, then, we know of no sure remedy for smut in corn.

THE LILY FAMILY (Order Liliaceae)

The Lily Family is made up of plants that with few exceptions have parallel-veined leaves. The flowers are regular and symmetrical with perianth of six parts, six stamens, and a superior three-celled ovary; fruit a many-seeded dry pod or soft berry. Besides the asparagus, onion, garlic, and leek, whose cultural directions are here given, there occur in this family the tiger and other lilies, the hyacinth, tulip, Spanish bayonet, century plant, smilax, lily of the valley, and many other familiar flowering plants.

ASPARAGUS (*Asparagus officinalis*)

Description.—Native of Europe. A perennial. The asparagus is an herbaceous plant, growing to the height of about four feet. The flowers are small and generally yellow. They are perfect, but in many plants the pistils are abortive, so that only about half of the plants produce seed. The seed is produced in spherical berries, that are vermillion in color when they ripen in the autumn. The seeds are black and triangular, numbering about 1400 to the ounce. They may be taken from the berry quite readily by macerating the fruit in water to remove the pulp and light seed and then drying the good seed.

Asparagus is one of the most valuble garden vegetables. It is perfectly hardy, never fails to produce a crop, is one of the first vegetables to be obtained in the spring, and may be used until the middle of June. Perhaps no other vegetable is more highly esteemed by those who are accustomed to its use. It may be grown with success in any good corn land, but is worthy of the best of care, as it responds readily to rich manure and high cultivation. On sandy loam the crop is much earlier than on clay soils; wet land is not suited to it. Large quantities of asparagus are grown in New Jersey, New York, and California, especially for canning. The white varieties are preferred for this purpose.

Fig. 63. Asparagus plant, full grown.

Propagation.—It grows readily from seed, and one ounce of seed is sufficient for about fifty feet of drill, and should produce with good care about four hundred plants, though no particular care is necessary for success. The seed should be sown in good soil early in the spring, in drills which may be as close as sixteen inches, and it should be covered about one inch deep. As asparagus seed starts slowly, it is a good plan to sow radishes or other early-appearing crop with it, so that the rows may be seen and weeding commenced early. This practice does not interfere with the growth of the asparagus as the radishes will be ready for use and out of the way before it needs much room. The seedling asparagus roots will be large enough for transplanting to the permanent plantation when one year old, and it is the best plan to do so, but they may be allowed to stand two years in the seed bed. The young seedling plants which often come up in or near asparagus beds may be transplanted in July of the first year directly to the permanent bed, and will do very well if handled carefully. At whatever age they are

Fig. 64. Asparagus root crown, with edible shoots.

transplanted the plants should be dug and set out in the spring or early summer, as they are likely to fail when removed in the autumn. Asparagus may be increased by dividing the crowns, but this is an expensive process, and plants so grown have no peculiar merit over those from seed. By buying the plants instead of sowing the seed to start with, one or two years' time may be saved, and frequently it is cheaper to buy the plants than to raise them. It is said that plants that do not bear seed produce more sprouts than those that do. Such plants may be increased by divisions.

Planting.—While asparagus should always be moved in the spring, it is not necessary to move it very early, though it is better to do so; but it may be successfully transplanted as late as the first of June. Any long sprouts that may have started should be broken off when the plants are set out. The land for planting should be heavily manured, deeply plowed, and finely pulverized; and it is important to do this work well, as asparagus beds well made should last at least twenty years. The opinions of different growers as to distance between plants vary much. It has been advocated to set the plants four feet apart each way and if the soil is remarkably fertile this distance will not be too great; if the land is not very rich, it is customary to put the plants at intervals of three feet in rows four feet apart. If a bed for a family garden is desired where space is limited, it is probably best to set the plants three by three feet apart. About 100 plants will produce all the sprouts needed in an ordinary home garden.

Depth to Plant.—For ordinary purposes asparagus roots should be planted about six inches deep; the deeper they are planted the later they will be about starting in the spring; if planted much less than six inches deep, the the roots often push up to the surface and interfere with cultivation. The plants should not be covered to the full depth of six inches at once, or the shoots may never be able to push up to the surface. The furrows should be made with a plow to the proper depth, the plants placed in the bottom of the furrow and covered about three inches to begin with, and the furrows filled in by after cultivation as the tops grow. By the middle of the summer the furrows should be level full.

Cultivation during the first year can be done almost entirely with a horse, though some hand hoeing will be necessary between the plants. By autumn of the first year, the tops should be three feet high. As soon as they are dead they should be cut off close to the ground with a heavy, sharp hoe or similar tool, and then the land should have a light plowing or be worked up with a harrow to a depth of four inches. No care need to be taken about the plants when cultivating at this season of the year, but the whole surface may be cultivated or plowed three inches deep as though no crop were on the land. In the spring the land should be cultivated as soon as it will work well, in order that it may warm up quickly. There will be no crop to cut until the spring of the third year; a very little. however, may safely be cut the second year after planting if the plants do well.

The cultivation in subsequent years should be very much the same as that given above; but in addition, when the crop has been all harvested and cutting is to cease, which will be about the middle or last of June in the Northern states, the whole bed should have a thorough cultivation to the depth of three inches without regard to the rows, and if manure is to be used it should be put on at this time. Under this method of treatment it is unnecessary to do much hand weeding, and it is very easy to keep the soil in the best condition by horse power. After the thorough cultivation in June, all the sprouts that come up from the roots should be permitted to grow until autumn, by that time they should be about five feet high if in good soil and will have ripe seed. It is necessary to allow the tops to grow to this extent in order that plant food may be stored up in the roots. Very late cutting weakens the growth of the plants.

Fertilizing.—Asparagus is a gross feeder, and it pays to apply barnyard and commercial fertilizers liberally. Sometimes these are applied in the fall or spring but probably the best time is in June after the last cutting has been made. Various amounts are recommended, from five to ten tons of barnyard manure, supplemented with commercial fertilizers, such as kainit and nitrate of soda. Manure should be broadcasted, especially between the rows, and plowed in. If left on the hills, it is apt to encourage the plant to form roots near the surface, which is always objectionable. Commercial asparagus growers sometimes expend from $50 to $100 per acre on fertilizers for their fields. Salt is not of much value on an asparagus bed, except as a weed killer, and it sometimes holds moisture.

Manure applied to the bed in autumn or before the frost is out of the ground in the spring, prevents the frost from coming out and so keeps back the growth, unless the manure applied is very fine and at once cultivated into the soil. Sometimes manure applied in the fall will keep the plants back a week or two in spring.

Cutting.—When the crop is grown for marketing, it is not desirable to cut the shoots until the third season after planting the roots; however in the case of small beds in the garden where the planter is very anxious to test the fruit of his labor, it may be well to note that no harm is likely to come from a very slight cutting the second season. The sprouts should be cut as they appear in the spring, and all of them should be cut when of the proper size, although they may not be needed at that time. If permitted to grow they interfere with subsequent cutting and prevent the growth of new sprouts. They will also be in the way of cultivation later in the season.

The sprouts are generally cut off about two inches below the surface when they are about six inches high above the ground. At this time all but two inches of the asparagus is green, which is the right condition for most markets. Some persons prefer to have white sprouts, and in such cases the shoots should be cut four or five inches deep in the ground. In case white sprouts are wanted it is also a good plan to mound up around the hills or to cover them with fine manure to keep the sunlight away from the shoots. The demand for green asparagus far exceeds

Fig. 65. Method of bunching asparagus, showing loose sprouts, a box for tying up in, and completed bunches.

the white, and is fully as good in quality. The time between cuttings is largely dependent on the weather. In early spring, if the weather is rather cold, the plants may not give more than one cutting per week, but later in the season a good cutting will perhaps be made once in two days. A severe frost will kill all the shoots above ground but will not injure subsequent cuttings.

Asparagus is marketed by tying the sprouts in bunches, and the size of the bunches depends much upon the market and, in some places, on the season and whether the supply is plentiful or not. It is very desirable, however, to have all the bunches of one size. Three grades are often made, known as extra, prime, and second, with sometimes a fourth, known as culls. These should be packed in neat, clean packages. It is preferable to tie the sprouts when they are just a little wilted and then set them in water to swell and make the bands tight. The shoots will easily keep for a week if kept cold and moist. It is customary to stand the bunches on end in water in keeping them.

Yield.—The manner of cultivation and the soil will determine to a great extent the yield of asparagus. Eastern growers get as high as 3000 bunches per acre. The gross income per acre may range from $250 to $500 or higher per acre on well kept acreage.

Forcing asparagus for early use is being done to some extent near large cities, where it is often a profitable undertaking. For this purpose the roots must be dug in the fall and carefully stored in earth in a cellar. In March, make a good, slow hotbed and put the roots in it in good soil. It is important to start the roots slowly, or the shoots will be spindling and weak. The roots stored as recommended may also be forced into growth in a warm cellar, shed, greenhouse, or a part of a permanent bed may be enclosed in glass or cotton sheeting.

Varieties.—Palmetto is one of the best varieties on account of its resistance to rust and its large-sized shoots. Conover's Colossal originated on the farm of Abraham Van Sichen, of Long Island, New York, and was introduced by S. B. Conover, a produce merchant of New York City. This is a good variety and is very widely planted. Argenteul is a French variety grown very largely about Paris.

There are two types of this, an early and a late. Other varieties are Moore's and Columbian Mammoth.

Insects.—The asparagus beetle (*Crioceris asparagi*) and the twelve spotted asparagus beetle (*Crioceris duodecim-punctata*) are the two principal insects. The beetles appear in early spring, and should be kept in check by keeping all shoots cut off, and after the cutting season ends spray with arsenate of lead, using two or three pounds in fifty gallons of water; or with Bordeaux, using resin soap to make the mixture stick to the foliage. Spray every two weeks if necessary. Apply air-slacked lime when young first appear, and during a hot day jar the plants to make the young drop to the ground, where they perish.*

Diseases.—Rust (*Puceinia asparagi*) is the only serious disease of asparagus. It causes the foliage and stems to turn brownish and to mature early. Spray with Bordeaux and resin soap every two or three weeks after the middle of July. Cut off and burn dead tops in the late fall. Good cultivation and plenty of humus in the soil, to retain moisture, will help to retard the serious injury of the disease.†

ONIONS (*Allium cepa*)

Description.—Native of central or western Asia. A biennial, sometimes perennial. The original home of the onion is not known. It has no true stem, but this is represented by the base of the bulb. The form, color, and shape of onions vary greatly in different varieties. The free portion of the leaves is elongated and is swollen in the lower part. The flowers, which are white or lilac in color, are borne in dense, round heads on long, slender, hollow stalks; sometimes, instead of flowers, a head of small bulbs is produced and no seed at all. This may occur occasionally in

*Bulletin 150, Maryland Experiment Station.
†Bulletin 151, Maryland Experiment Station.

all kinds, but is the almost invariable characteristic of tree and top onions. The seeds are black, angular, and flattish. Usually the plant dies after seeding and disappears entirely, but sometimes seed onions produce peculiar pointed bulbs, called cloves, as well as seeds. Such plants may be considered perennial, and also the potato onion, which never seeds and is propagated by the division of its bulbs.

The onion has been cultivated from remote antiquity, and there are very many varieties that have been developed for different purposes. These are almost without exception grown for their bulbs, but in a few cases no bulbs are formed. The bulbs are white, red, and yellow in color, with intermediate shades. In the successful raising of the onion, good judgment and experience play an important part. Perhaps no other vegetable crop is more certain to pay the skillful grower for his time and labor, and no other is more liable to cause trouble to the careless beginner, and yet its cultivation is quite simple.

The prices for onions vary greatly. They seldom are so cheap as to make the crop unprofitable: but occasionally they get down to fifteen cents per bushel, at which price they cannot be grown at a profit. There are few animals that eat onions, and if not sold they can not be fed to stock on a large scale, as is the case with most vegetables. As a money crop for careful growers in many sections they are among the most reliable: and if a reasonable amount of them is raised each year without regard to the price the preceding year, it is a crop that will generally average a good profit.

Soil.—Onions may be raised on any good, retentive soil. Sandy land is too apt to dry out in summer for best results. On drained muck land, large crops may be easily raised; although onions grown on such soil are often a little looser in texture than those raised on drier land. The land should be rich, fine, and free from weeds and any strawy manure or other material that would interfere with close cultivation. Too much stress cannot be put on having the land free from weed seeds, since it is a crop that requires much hand weeding and the plants are quite delicate when young. The soil should be rather firm for onions and plowed in the fall rather than in the spring. Fall plowing leaves the soil firm and in excellent condition for the crop. Sometimes when the land is rich it is desirable not to plow at all, especially if it produced onions the preceding year, but, instead, to make a seed bed by the use of a disk or other good harrow, and plant at once; in fact, better results will generally be obtained from spring harrowing than from spring plowing of land to be used for onions. Of course, when the land is prepared by harrowing only, any manure applied should be very fine, so as to be properly covered.

Old land is generally preferred for onions, and this crop is often successfully raised on the same land for many years. From the fact that onion land is always most carefully attended to and gets much manure and tillage, it is generally in better condition for onions than land used for almost any other crop. It is a good plan, however, to change the land occasionally for onions, since on new land there is far less danger from disease and insect enemies than on old land. Land that has grown any crop requiring high culture and heavy manuring and is free from weed seeds will generally grow good onions. Sometimes onions are raised on newly cleared woodland or prairie sod with greatest success simply by sowing the seed broadcast and harrowing it in; but this is seldom attempted.

Sowing the Seed.—Before sowing the seed the land should be made very smooth. It is very important to get the seed in the ground as early in the spring as possible. As soon as the land can be worked in the spring, the seed should be sown, and the earlier it is sown the better. The seed of some kinds can be sown in the autumn to advantage, but on land that is inclined to "bake," it is a bad practice and is seldom attempted. There is, however, a fair chance of a crop even if the seed is sown as late as the first of June, but a first-class crop from seed sown as late as this is almost out of the question. By the middle of May, all onion land should have been sown.

The proper distance between the rows will depend somewhat on the variety grown, but for ordinary purposes the seed should be sown in rows twelve to fifteen inches apart and covered one inch deep. About eighteen good seeds should be sown to each foot of row, which will make it necessary to use four or five pounds of seed per acre. If there is danger of much loss from the depredations of the onion maggot, more than this amount of seed should be used; where maggots are very troublesome some growers use as much as six pounds per acre. The seed sower should be carefully tested on a floor or other smooth surface before using it in the field.

It is very important to know the germinating qualities of the seed sown, since if it is of low germination more must be used than if it is of best quality. Ninety per cent of good onion seed ought to germinate if the conditions are favorable. It is important to study these matters closely, as it is desirable to have the land well stocked with plants and yet not overstocked. It is better to fail of getting quite enough seed on the land as is desired, than it is to get very much more than is wanted; for in the first case the onions, although somewhat scattering, will be of good size;

while if the plants are too thick they must be thinned out, or the onions will be small and inferior.

The work of thinning onions on a large scale is a very expensive operation, and every precaution should be taken to avoid having to do it. If the seed is sown only a little thicker than the plants ought to stand, it is sometimes a good plan, instead of thinning them out, to put on an extra dressing of some quick-acting, easily-applied manure, such as hen manure, which will probably make it possible for the land to mature the whole crop in good shape. Onions have the quality of crowding out to the sides of the rows and on top of one another, so that they may grow pretty thick and still be of good size, providing other conditions are favorable to their development.

It is important to have the seed sown in straight rows. If the first row is laid off with a line or otherwise made straight, the subsequent rows are easily made parallel to it by means of the marker on the seed sower. If some vacancies are found in the rows after the onions appear, they may be filled by sowing onion seed in them by hand; late in the season such vacancies may be sown with carrot seed.

Cultivation.—As soon as the plants commence to break the surface soil, cultivation should be commenced with a hand cultivator that will work both sides of the row at one time and throw a little earth from the plant; hand weeding should follow at once. At the second hoeing, the plants being now pretty strong, the soil should be cultivated somewhat deeper. This will enable a careful man to work the soil very close to the plants. Onions grow naturally in the surface of the land and not below it, and should never be hilled up. The onion crop should be hoed and weeded as often as the weeds appear or whenever the ground packs hard around the growing plants. The weeds should be destroyed when small. This means that until early summer the onions should be hoed about once every two weeks.

When the plants get so large that they will no longer pass under the straddle cultivator without being bruised, the work of cultivation must be continued between the rows until the bulbs commence to form, after which it is not a good plan to work much among them, since pushing the tops about tends to make them die down more quickly than otherwise. When the onions are about the size of a half dollar and before the tops fall over, it is a good plan, if the land is not very rich, to apply some quick-acting fertilizer such as hen manure or a commercial fertilizer broadcast over the crop. This should be done just before or during a rain if possible. For this purpose dry, fine hen manure is good, but any rich, nitrogenous fertilizer will answer.

Harvesting.—If the plants are going to make good onions they will become weak in the neck just above the bulb when nearly grown and fall flat on the ground, where they should be allowed to lie undisturbed until the tops and roots are entirely dried; then the bulbs can be easily pulled out of the ground with a rake or onion puller. In the vicinity of St. Paul, this time will be in August or the early part of September. About four rows of bulbs should be thrown together, and they should be turned with a rake every few days until perfectly dry and then be put under cover to protect them from rain. If they are allowed to get wet several times after being pulled, the outer skins are apt to come off and thus make the bulbs unsightly. If not pulled for some little time after they are ripe, especially if the season is moist, new roots are very sure to start and the roots become grown so firmly into the soil that the work of pulling and drying them is increased. The work of cutting or twisting off the tops, called topping, may be left until the onions are marketed; but they will be found to keep much better if "topped," since if the tops are left on they prevent a free circulation of the air through the bulbs.

"Scallions" or "Thick Necks."—Sometimes, too, the tops of the plants do not die down as they should, but remain green and continue to grow after the bulbs are well formed, becoming what are called "scallions" or "thick necks." This is generally due to the planting of poorly selected seed, but sometimes it is not to be accounted for. In such cases it is generally recommended to break the tops down, which certainly does no harm, but is of doubtful value. A better way is to pull such plants as soon as they begin to grow vigorously after once having formed good bulbs, dry them as much as possible, and remove the tops. Such onions do not generally keep well, however, and had better be used during autumn and early winter.

Keeping Onions.—Onions should be kept in a dry, cool place. In a damp cellar they will sprout and grow, no matter if the temperature there is near the freezing point. They will stand quite a little frost without much injury, but if frozen and thawed several times they become soft and do not keep well, but start to grow quickly. The best place to keep onions is in a cold, dry room in slatted bins or on shelves so arranged that the air can circulate through them. A very practical plan is to put them in barrels without heads, having holes in the bottom and sides, and pile these on top of one another two tiers high, first putting down scantling or other material to allow the air to circulate under and around them.

If our common onions are frozen solid in the autumn and kept so all winter, they will generally come out right in the spring. A good way to do this is to lay them eighteen inches thick on the floor of a loft and cover with a foot or so of hay. Thus arranged they will not freeze until severe weather sets in and will remain frozen until spring. They may also be put in water-proof bins in the field where grown and treated in the same way. They should never be handled when frozen, as they are apt to bruise. Freezing and thawing several times seriously injures them, but if kept frozen and gradually thawed out they come out in very nice condition. After thawing out, they will not keep well, but quickly start to grow, and should be disposed of at once. The Prizetaker and similar kinds are an exception to this rule and are likely to be ruined if frozen.

Onion sets is a term applied to small onions that are planted out in the spring instead of seeds. If onions under three-fourths of an inch in diameter are planted out in the spring, they do not go to seed as do larger onions, but form new bulbs, much earlier than they are formed when grown from seed. Taking advantage of this fact, it has become a common practice to raise these small onions (sets) and plant them out for early summer use. It does not matter how small the set is, and one the size of a pea is as good as one much larger. The size generally preferred is about one-half an inch in diameter.

Planting Onion Sets.—The method of planting sets is to have the land in the same condition as recommended for onion seed and plant the sets as soon as the soil can be worked in the spring. In doing this mark off the land in drills twelve inches apart and push each set down firmly three inches deep into the mellow soil, leaving them three inches apart. This is done by hand, and each set is handled separately, so as to have them right side up. The drill is then closed in with the feet or rake, so that each set is entirely covered up. If the ground is dry, it is sometimes rolled to make it still more compact around the bulbs, but it is generally quite moist when the sets are planted in early spring.

As soon as the rows can be seen, the wheel hoe is used, and the plants kept free from weeds and the soil well stirred. By this method we shall have onions of good table size by the first of July, and some may be marketed in bunches in a green state in June. Onion sets seldom, if ever, fail to produce good crops, and are well adapted for use in the home garden and by those who will not take the pains necessary to grow good onions from seed. No matter how poor the soil or the cultivation where the sets are planted, they always increase in size and ripen early. There is no danger of their being injured by freezing after being planted. From six to ten bushels of sets are required per acre, depending on their size.

The raising of onion sets is carried on to a large extent in some localities, and it is a crop that requires much skill in handling. Sandy soil of rather inferior quality but free from weeds and in fine tilth is best for this purpose. To keep the sets from growing too large, it is customary to plant from thirty to fifty pounds of seed per acre, and not plant it until the latter part of May. This treatment crowds the seedlings so that they cannot grow large. In sowing the seed, it is best to go over the rows with the sower three or four times, sowing only a part of the seed each time. This spreads the seed out in wide drills and permits of more even work than would be possible were it attemped to sow all the seed by going over the rows once. If onion sets grow too large it is often almost impossible to use them for any purpose, since they are too small to sell well except for pickling, and the demand for this purpose is very limited. On this account, if it is feared the sets will grow too large, they are pulled when of the proper size, even if still quite green. The further cultivation of plants for sets is the same as for a field crop of onions.

Fig. 66. At the left, onion plants as dug; on the right, onion plants trimmed and ready for transplanting.

The sets should be taken up in August, or as soon as ripe, with a rake or onion set puller. When dry they should be stored, tops and all, about four inches deep, in a loft, where they should be covered with a foot of hay or straw on the approach of hard frost and left until wanted for planting in the spring. In other words, they should be kept frozen all winter. Treated in this way they will require cleaning in the spring, which may be done by rubbing them in the hands to loosen the dirt and tops and then running them through a fanning mill. After this they are run over a screen with a three-fourths inch mesh, and only those that go through it are saved for sets. This work of cleaning may be done in autumn before storing and the sets mixed with chaff to aid in keeping them over winter.

Transplanting Onions.—Within a few years some market gardeners have adopted a plan of raising onions by sowing the seed in March in a hotbed and then transplanting the seedlings to the open ground as soon as it works well. This system has the merit of doing away with the first few weedings in the open ground, reduces the expense of seed to a minimum, and makes it possible to raise some of the more delicate foreign varieties of onions that command the highest price in the market. It is very doubtful, however, if the common field onions can be raised at a profit under this method, but it is desirable if the Spanish kinds are to be raised in Northern states.

The selection and preparation of the land for this purpose are the same as for a field crop. The seed is sown in a hotbed in rows three inches apart, or on a small scale a few plants may be raised in a box in the window of the living room. The soil for this purpose should be somewhat sandy loam of only moderate quality, and that which has no manure in it is most certain to grow healthy plants. If very thick in the row, the plants must be thinned out so as not to crowd one another too much, but still they may be grown very thickly; as many as twelve to fifteen plants to the inch of row is about right, and to secure this amount about twice as many seeds will have to be sown to the inch. Too much importance cannot be attached to the raising of strong plants, since those that are weak and splindling are very certain to fail when removed.

For a week or two previous to setting out the plants, they should have plenty of fresh air, and it is a good plan to remove the sashes entirely from over them except when there is danger of frost. In this way the plants may become hardened off, as otherwise they are liable to serious injury by freezing when moved to the open ground. They will stand some freezing weather when well hardened off. They do not transplant so well when soft and succulent as when properly hardened. The land and preparation required are the same as for a field crop of onions. The plants should be set two or three inches apart in rows

Fig. 67. Transplanting onions in the field.

twelve inches apart. Before setting, the tops should be mostly cut off, and this is especially important if they are weak and spindling, as they are then very sure to turn yellow and die. If the roots are excessively long, they may be shortened to facilitate transplanting.

The plants are generally set in small furrows opened with a hand cultivator or with a marker. The lower part of the bulb should be about an inch deep in the ground. The plants are easily moved, and if the soil is well firmed they are very sure to live. About 150,000 plants are required for an acre, and it is a big job to transplant them. For this purpose children can generally be employed at low wages and they will do the work very well if carefully looked after. The expense of transplanting is variously estimated at from $25 to $50 per acre. Subsequent cultivation is the same as for a field crop of onions.

Marketing.—In a general way the directions for marketing onions apply to any other crop. They should be sold as soon as a fair price can be obtained for them, and not stored unless there is a good chance of a rise. In some localities there is a large demand for onions for bunching purposes before the bulbs are formed. In these places it will sometimes pay to pull and sell the crop before the tops have died down, but generally it should be allowed to ripen. The foreign kinds such as can only be raised here by transplanting method, are generally highest in price in early autumn and should then be sold. The tops should always be removed before the bulbs are marketed, and all small bulbs should be picked out and sold separately for pickling purposes.

Most markets prefer onions of medium size, globular rather than flat in shape, and yellow or white in color rather than red. Very large onions of the common type are not so salable as those of medium size; but of the foreign kinds the larger the better, and good specimens sometimes weigh as much as two pounds. When marketed in quantities they are often sold by the hundred-pound sack.

Yields.—The United States produced about $10,000,000 worth of onions in 1908 and imported about 1,400,000 bushels from Spain, Bermuda, and other countries. Growers average from three to five hundred bushels per acre. Skillful growers get yields of from 800 to 1000 bushels per acre.

Onions for the home garden should be raised partly from seed and partly from sets or transplanting. The small onions picked out from one season's crop may be used as sets for the next year, when they will give a much earlier crop than those grown from seed.

Varieties.—For general field crops in the Northwest varieties of the Globe type are now the most popular.

Fig. 68. Varieties of onions; *1*, Southport Yellow Globe; *2*, Silver Skin; *3*, Red Globe; *4*, Prizetaker; *5*, Yellow Danver.

Among these may be mentioned the Red, Yellow, and White, Globe onions. The Yellow Danvers is another of the Globe type. Red Wethersfield is the old standard red flat variety, not as desirable as the Globe. The earliest maturing large kind is Extra Early Red. For raising sets, the Yellow Dutch, called also Yellow Strasburg, is the best, but any variety may be used for this purpose. For growing in hotbeds, greenhouses, or window boxes and transplanting to the open ground, the Prizetaker and the Southport Yellow Globe are most in demand.

Potato onions and shallots are always grown from the bulbs, which increase in size and also produce a cluster of bulbs (cloves) around the one that is planted. They are especially adapted to early marketing in the same way as onion sets.

Egyptian, or Perennial Tree, Onion.—This kind is perfectly hardy and does not form bulbs, but the blanched stem is used in a green state. It produces no seed, but instead has a small cluster of bulblets where the seed cluster should be. These bulblets are planted in September in the same way as recommended for onion sets and are ready for use as bunch onions very early the following season.

Fig. 69. Field of seed onions in bloom, Minnesota. (Photo courtesy *The Farmer*.)

Top onions is a name applied to a class of onions that produce no seed, but where the seed should be have a cluster of small bulbs. These small bulbs when planted grow into large common onions, and when these common onions are planted they produce a crop of sets.

Onion seed is raised by planting out the bulbs in the spring in rows four feet apart, and for this purpose bulbs of the greatest excellence are used. It is best to set the bulbs about six inches deep and six inches apart in each furrow, and to do this planting out very early in the spring. The seed stalks will attain a height of about three feet. The seed clusters ripen somewhat unevenly, but should be gathered before they are quite dry, or the seed will shell out and be lost. When gathered, they should be dried in airy chambers and afterwards threshed out and cleaned with a fanning mill, or they may be cleaned by being thrown into water. The latter method insures the best seed. All seeds that are full and plump will sink in water, and as the chaff and lighter seeds float they are readily separated from the good seed. Some of the seeds that float will grow, but are not very desirable for planting. The same land that grows a crop of onion seed is sometimes used for growing a crop of cucumbers or melons at the same time, since the onions do not shade the land or take much nourishment from it except early in the spring.

COMMON GARLIC (*Allium sativum*)

Description.—Native of southern Europe. A perennial. All parts of the plant have the well-known strong, burning taste. The bulbs or beads are composed of about ten cloves enveloped by a very thin, white or rose-colored membranous skin. The plant hardly ever flowers, and is grown by means of the cloves, for which purpose those on the outside of the cluster should be used. These should be planted in good rich soil in about the same way as onion sets. They should be gathered after the bulb clusters are well formed. This vegetable is scarcely used in the North; in southern European countries it is quite common. It is said that it has a much stronger burning taste when grown in the north than when grown in the south. What is known as common garlic is the kind most generally used.

Fig. 70. *1*, French shallots; *2*, top onions (red); *3*, Jersey shallots; *4*, garlic; *5*, potato onions.

LEEKS (*Allium porrum*)

Description.—Said to be a native of Switzerland. A biennial. The leek is closely allied to the onion, which it resembles in flavor, color of seed, and flower. It does not form a bulb, however, but a straight bunch of leaves, which are used almost entirely in a fresh or uncooked condition. The leaves are flat instead of round and hollow, as is the case with onions. As yet this vegetable is little grown in this country, except around the large cities.

Cultivation.—Its requirements are about the same, and it may be cultivated in much the same way, as the onion, but it is more common to sow the seed early in spring and transplant in summer, setting plants very deep, as the market value depends on the blanched condition of the stem; and for the same reason in hoeing the soil is drawn up over the stem. They transplant very easily when the soil is moist, but should have the tops trimmed off as recommended in transplanting onions. If they are not transplanted, especial care should be taken to draw the soil towards the plants in hoeing. They may be stored in the same manner as celery, and are marketed in bunches the same as green onions.

Fig. 71. Leek.

Varieties.—There are several varieties, which vary in form and color.

Large Flag leek is a popular sort and is, perhaps, more largely grown than any other.

Scotch Flag or Musselburgh leek is longer than the Large Flag but not quite as thick.

CHIVES (*Allium schoenoprasum*)

Description.—Native of Europe. A perennial. A hardy plant growing in thick tufts. Bulbs are oval, scarcely as large as a hazelnut, forming compact masses; leaves very numerous, grass-like in appearance, and hollow. Flower stems are in terminal clusters of violet-red flowers and are usually barren. The tops have an onion-like flavor and are used in seasoning.

Culture.—Chives are propagated by dividing the tufts. They are not much used and are generally grown as edgings for beds in the garden, for which purpose they are a pretty ornamental. It is of the easiest culture.

THE BUCKWHEAT FAMILY (Order Polygonaceae)

The Buckwheat Family includes herbs with alternate entire leaves, and stipules in the form of sheaths above the swollen joints of the stem. Flowers mostly perfect, with a one-celled ovary bearing two or three styles or stigmas. Fruit usually an achene, either flattened or three-or four-angled or winged. Sometimes agreeably acid, as sorrel, and sometimes cathartic, as the roots of rhubarb. Only rhubarb is here discussed, but other familiar plants that belong to this order are sorrel, bitter curled and other docks, knotwood, smartweed, bindweed, or wild buckwheat, and field buckwheat.

RHUBARB, OR PIE PLANT (*Rheum rhaponticum*)

Description.—The cultivated varieties of rhubarb are generally supposed to have come from Mongolia, though it is quite possible that some varieties may have sprung from a North American species. The plant is an herbaceous perennial whose leaf stalks are used for sauce, pies, etc. It sends up a flower stalk often four feet high, and produces a large amount of seed each year. It is perfectly hardy in gardens, even in very severe situations, and when once planted continues to yield abundant crops for many years. The seeds are large and triangular.

Culture.—Rhubarb is readily increased from the seed, which germinates quickly. Seedlings vary considerably but not enough to prevent this method of propagation from being the one most commonly practiced. They attain good transplanting size in one year. It is customary to sow the seed in rows three feet apart early in the spring, and to set out the plants when one year old where they are to grow; the plants may be also be thinned out and a few allowed to remain where the seeds are sown. When it is desired to propagate the specially valuable qualities of individual plants, it is done by dividing the roots, using care to take at least one good bud with each piece of root. This is the only sure way of getting the best plants.

Fig. 72. Rhubarb plants in flower.

It is preferable to set the plants out in the fall where they are to grow, but early spring planting is often followed. They should be set in the richest of land, four feet apart each way. The stalks should not be pulled up until the spring of the second year and then only to a small extent; the third year they should give a good crop. The only culture needed is to keep the soil loose, free from weeds, and to use plenty of manure. Twenty-five tons of stable manure per acre are sometimes applied. Stable manure is better than commercial fertilizers, because it also supplies humus and helps hold moisture in the soil. In gathering rhubarb the stalks should be removed from the crown by a jerk downward and sideways, and care should be taken not to be so rough about it as to pull the buds from the crown at the same time. There is little danger of pulling more leaves than the plant can stand without injury, but in the case of a young plantation it would not be well to remove more than one-half of the leaves at any one time. The stalks are most in demand early in the spring, but there is more or less call for them all summer. The seed stalks should be cut off as soon as they appear, so as

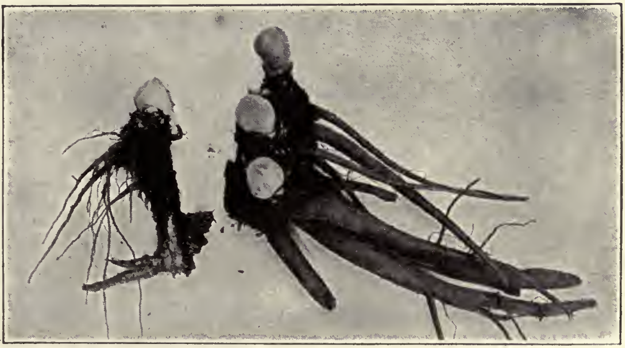

Fig. 73. Pieces of rhubarb roots cut off for planting out.

to throw their strength into leaves and to prevent the formation of seed, if the largest amount of stalks is wanted.

Forcing Rhubarb.—For winter and spring use rhubarb is often forced in greenhouses and cold frames. The roots of any age are taken up in autumn, crowded together under the benches in greenhouses or placed in boxes or barrels with a little soil between them, and then in February are put in any convenient place in the greenhouse or in a warm light room or cellar where they start into growth. They are also planted out in warm sheds. When a business is made of forcing rhubarb in sheds, two-or three-year-old plants that have been grown especially for the purpose are generally used. No rhubarb should be pulled during the summer from plants that are to be forced in winter.

Still another way of forcing rhubarb is by putting a cold frame over the plants in the early spring where they are growing in the open ground. This method may be improved by heavily mulching the plants so as to keep out the frost in winter. The roots are sometimes lifted in autumn, planted close together in a deep cold frame, and covered with leaves to keep out frost. In March the leaves are removed and the sashes put on. This method has the advantage of using the sashes to the best advantage, but roots that are dug and then forced are worthless for further planting. In order to increase the length of the stalks it is a common practice where but a small amount is grown to put headless barrels over each plant in the spring when the leaves are starting into growth, and in striving to reach the light the leaf stalks naturally grow long and tender. The growth of rhubarb treated in this way may be hastened if heating manure is piled about the barrel. An old sash laid over the barrel is an improvement on this method.

Rhubarb is always forced in the dark, since this allows the formation of but a very small leaf. For home use a hill may be dug late in the autumn and stored in a cool place until about the time rhubarb is wanted, when it may be placed in a warm cellar, covered with dirt, and watered. It soon will give a supply of tender shoots.

Varieties.—There are several varieties, but the following kinds are the most highly esteemed:—

Myatt's Linneus, an early sort having deep green stalks and attaining to a large size.

Myatt's Victoria, a much later kind than the preceding; stalks red, very thick and large.

THE GOOSEFOOT FAMILY (Order Chenopodiaceae)

The Goosefoot Family includes chiefly homely herbs with inconspicuous greenish flowers. The ovary is one-celled and one-seeded. Leaves are chiefly alternate. Besides the beet, mangel-wurzel, Swiss chard, and spinach, whose cultural directions are here given, this family includes such weeds as Russian thistle, goosefoot, and lamb's quarter or pigweed.

BEET (*Beta vulgaris*)

Description.—Native of Europe. A biennial. This plant in the first year of its growth forms a fleshy root, and goes to seed the second year. The seed stalk is about four feet high. What is usually sold and planted as beet seed is in reality a fruit, and is made up of several seeds imbedded in corn-like calyxes; the seed itself is very small and kidney-shaped, with a thin, brown skin. The roots vary greatly in form and size and in color from a reddish white to a deep dark red. Some varieties have special qualities for table use, while others are valuable for feeding stock or for sugar only.

The garden beet is easily grown and is a very reliable crop. It prefers a very rich, sandy, well-worked soil, but will grow in any land that is fit for corn. For early use some early-maturing kind should be selected, and the seeds should be sown in rows sixteen inches apart in the open ground as soon as the soil can be worked in the spring. Ten seeds should be sown to each foot of row and covered one inch deep. The young plants will stand quite a severe frost without injury.

As soon as the seedlings appear they should be cultivated with the wheel hoe, and the cultivation repeated at frequent intervals. When they are eight or ten inches high, thinning should be commenced and continued until the plants are six inches apart in the rows. These thinnings make excellent greens. If sown as recommended, they will be large enough for table use in June and will be good for use the rest of the summer. For winter use, the seed should not be sown until the last of May or first of June. For late planting some growers prefer to put the rows two feet or more apart so that when the plants are nicely started they can be cultivated by horse power.


Fig. 74. A bunch of Eclipse beets.

Stock and sugar beets should be sown in rows about thirty inches apart, to allow of easy cultivation. Seed should be sown from the middle to the last of May, and covered somewhat deeper than is recommended for early table beets, perhaps one and one-half inches deep. The importance of very early and constant cultivation cannot be too strongly insisted on.

Beet seed may be sown by a machine seed sower, but most of the sowers in use will need a little more careful watching when sowing this than most other seeds, as the rough seeds (fruit) are apt to clog the feed hole. There are a few beet seed sowing machines adapted for horse power that it will probably pay one to use where a large amount of land is to be cultivated in beets. About six pounds of seed are required per acre, and it is always a good plan to sow an abundance of seed, as it does not start very uniformly. Beets yield from three to four hundred bushel per acre, often bringing a gross income of $150 to $500 per acre.

Forcing Beets.—Beets are easily forced by sowing the early-maturing kinds in February or March in hotbeds, where they may be left to mature or may be transplanted when of proper size. It is, however, best to allow them to grow to table size without transplanting, which always puts the plants back and from which they recover slowly.

Harvesting and Keeping Beets.—On the approach of severe weather—in Northern sections about the middle of October—beets should be pulled and the tops cut or twisted off, but the top of the root should not be cut off. Light frosts do not hurt them much, especially when they are protected by a heavy growth of foliage, but when the surface of the ground freezes hard there is danger of permanent injury to the roots. Beets are easily kept in a cold cellar. It is generally best to pit them outside when dug and allow them to remain there until severe weather sets in. If the air of the cellar is very dry the beets should be covered with earth after being put into bins, or they will wilt and become corky. Beet seed is grown by planting out the roots about the middle of May, two feet apart in rows three feet apart. The seed ripens in the summer and is generally threshed off as soon as ripe.

Varieties.—There are many varieties of garden beets, and they vary considerably in size, form, and color, time of maturing, and other characteristics. Among the most valuable are the following:—

Eclipse, a very early, dark-red, turnip-shaped beet of good quality. Valuable for early or late sowing. A favorite with market gardeners.

Egyptian, valuble for early sowing.

Bastian's Early Turnip Beets, a valuable early sort, tender, sweet and good in every way; one of the best for early or late planting.

Crosby's Egyptian, a very early blood turnip. The Detroit Dark Red turnip is very easily grown.

Diseases of Beets.—The beet is subject to several diseases, and it is most healthy when grown on new land.

Beet scab is a disease which ruptures the skin of the beet in a manner similar to scab on potatoes. Recent investigations show that this disease is the same as potato scab. On this account, beets should not follow potatoes on land that has grown a scabby crop unless there is an interval of several years between them. Beets are sometimes subject to a rust that injures the foliage, but seldom very seriously.

Stock Beets (often called mangel-wurzel).—Stock beets are gross feeders and prefer rich soil. They require the same care as table beets, but the rows should be thirty inches apart, so as to allow of cultivating them with horse implements. The seed may be sown with any common garden drill after first laying off the rows with a marker, or it may be sown with a common grain drill by stopping the flow of seed through a part of the holes. It is a very good plan to sow radish or rutabaga seed with the beet seed, as it starts quickly and the line of the row is thus easily seen, so that cultivation may be started early. This is very important in land that is somewhat weedy.

About six pounds of seed to the acre will give about twelve seeds (fruits) to a foot.

There are many good varieties of stock beets. Among the best are Long Red, Yellow, or Golden Tankard, Yellow Globe, and American Sugar. The latter is not a true sugar beet, but is much richer in sugar than the ordinary varieties of stock beets and, possibly, of better feeding value.

Sugar beets, from which is made a large amount of the sugar of commerce, are grown in a similar way to stock beets, but on a large scale they require a rather different and special treatment. There is no trouble about raising them with a large percentage of sugar in any of the Northern states, but the drawbacks to beet growing as a general industry are the very expensive machinery required to extract the sugar economically on a large scale, the small margin of profit, and the low price the manufacturers have been willing to pay for the beets. Sugar beets grow entirely below ground, which makes them difficult to dig, and they do not grow to a large size, seldom weighing more than four pounds. The part of a beet above ground does not contain much sugar. It is recommended to sow about 18 pounds of seed per acre.

Fig. 75. Sugar beet.

LEAF BEET, OR SWISS CHARD

Description.—Native of southern Europe. A biennial. This appears to be exactly the same plant as the common beet, except that in its case cultivation and selection have developed the leaves instead of the root. The botanical characteristics, especially of the fruit seed and flowers, are precisely alike in both plants. The root is branched and not very fleshy; and the leaves are large and numerous, with the stalk and midrib fleshy and very large. The plants vary in color from deep red to nearly white. The fleshy leaf stalks are cooked and served like asparagus.

Fig. 76. Swiss chard.

Culture. — The plants are grown in the same manner as the common table beets. Among the best varieties is one known as the Silvery Swiss chard.

SPINACH (*Spinacia oleracea*)

Description.—Properly a native of western Asia. An annual plant cultivated for its leaves, which form popular spring and early summer greens. It has a seed stalk about two feet high. The varieties are divided according to their seeds into round and prickly-seeded sorts. The latter have sharp, hard prickles on the seeds. This division is so pronounced that some botanists have treated these classes as distinct species. The prickly-seeded sorts are regarded as hardier, while some of the round seeded kinds are perhaps the most desirable varieties for table use; but this difference is not always very clear.

Culture.—The seed of spinach may be sown in hotbeds or cold frames very early in spring, or outdoors as soon as the ground can be worked. It is of the easiest culture. A supply may be had during the whole growing season by making a succession of sowings at intervals of about two weeks. Under good conditions it will be ready for table use in about six weeks from the time of sowing the seed. In planting it outdoors the rows should be about twelve inches apart. The seed should be covered about one inch deep and about forty seeds or more sown to the foot of row. It is well to use plenty of seed, and since it often starts poorly in dry weather extra precautions are taken when sowing it at that time. The plants may be thinned out when too thick, and no matter how small they are they form a good vegetable.

Fig. 77. Spinach.

Spinach is often sown in the spring among early peas, cabbage, potatoes, or other slow-growing crop. For early spring use, the seeds of the hardiest kinds should be sown in Northern sections the latter part of August. The plants should grow well and attain a good size during the cool weather of autumn, and on the approach of winter they should be covered with about two inches of straw, hay, or similar material. When thus treated the crop generally comes through the winter without serious injury, and after making a little growth in the spring is marketable. It is harvested by cutting the plants off at the top of the ground. For this purpose a short push hoe is run under the plants. They are then freed from dead leaves, and after being washed are ready for marketing.

Spinach requires a very rich soil and plenty of well-rotted manure. To secure the best results from early spring sowings, it will pay those raising it for market to use nitrate of soda on the land in small quantities, say two applications at the rate of seventy-five pounds per acre at intervals of two weeks after the crop has started. This material has a wonderful effect on early leaf crops. Where nitrate of soda is not used, hen manure is very desirable. The effect of nitrate of soda on this crop is very marked and often results in more than doubling its size. Spinach generally is very free from insects and fungous diseases.

Varieties.—There are a number of varieties of spinach, differing in earliness, hardiness, and in the time they remain in the edible condition, as well as in many minor matters. Among the best are the following:—

Long Standing, an excellent sort for spring and summer sowing, since it stands longer than any other sort before going to seed.

Prickly, or Winter, a prickly seed variety that is very popular. It will withstand very severe weather without serious injury if lightly protected by hay or straw, and is probably the best sort for autumn planting in this section.

Bloomsdale, a nice hardy sort with long, curled leaves of excellent quality. Very hardy.

THE CABBAGE FAMILY (Order Cruciferae)

The Cabbage Family is made up of herbaceous plants having watery juice, a pungent (peppery) taste, and floral envelopes arranged on the plan of four, with their petals generally spread out in the form of a cross. Stamens six, two of which are shorter than the other four. Seed all embryo. This is a large family and, besides the cabbage, includes cauliflower, Brussels sprouts, kale, kohl-rabi, horseradish, cress, water cress, whose cultural directions are given under this head; among common weeds, the mustard, French weed, false flax, pepper cress, shepherd's purse; and many garden flowers, such as nasturtium, gillyflower, candytuft, and alyssum.

CABBAGE (*Brassica oleracea*)

Description.—Native of Europe and western Asia. A biennial. It grows wild to the height of three or four feet,

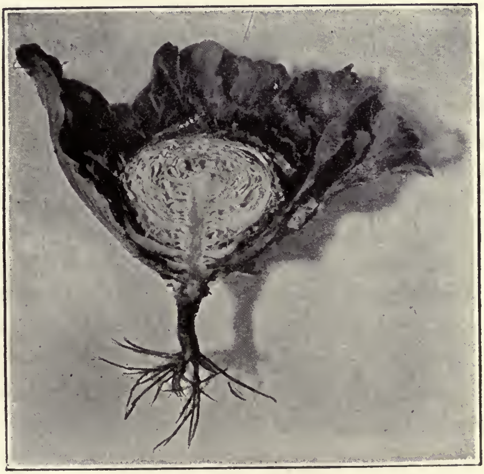

Fig. 78. Cross section of cabbage head, showing arrangement of stem and leaves, and that it is simply a big terminal bud.

and scarcely resembles any of our cultivated kinds. The part of cabbage eaten is termed the head, and is simply a cluster of leaves enwrapping the top of the stem, or is, in other words, a large bud. It attains the height of three or four feet and then goes to seed. The flowers are generally yellow in color, and conspicuous, though not large.

There are three great groups of cabbages, distinguished, respectively, by (1) red leaves, (2) smooth leaves, and (3) wrinkled leaves. Red cabbages are esteemed chiefly for pickling. The varieties with smooth, light-green leaves (common cabbage) are commonly cultivated; while the Savoy cabbage, which has wrinkled leaves, and is of the best quality, is little grown because it does not produce as abundantly as the common kinds. The original species from which the cabbage has sprung is also the parent of the cauliflower, kale, and Brussels sprouts. The seed of the cabbage is dark brown in color, and is smooth and round.

Soil.—The best soil for cabbage is a rich alluvial or prairie loam, moist, yet well drained and in fine condition. While some varieties will mature on poor soil, yet they all require the highest cultivation for the best development. This is especially true of early cabbage, which needs much richer soil than the late crop. It is a good plan to change occasionally the land used for cabbage; in some Eastern sections it is necessary to do this each year on account of the prevalence of the disease called clubroot, which is not commonly found in newer sections.

Manure.—The cabbage is a gross feeder and needs lots of rich manure. Most of our best growers apply manure broadcast; but when there is a necessity of economizing with the manure, it may be applied to better advantage in the hill, providing the land is in good condition. In growing early cabbage it is an excellent plan to apply a handful or so of dry hen manure around the hills when the plants are half grown. This should not be put close to the plants, but scattered over a radius of a foot or more from the plants and then cultivated into the soil.

Early Cabbage.—The methods of cultivating adapted to the growing of early cabbage are quite different from those followed in raising late cabbage, and the subject of cultivation naturally groups itself under these heads. The soil preferred for early cabbage is a light, rich, sandy loam, well drained, and sloping to the south, providing it is not too liable to injury from drouth. In milder sections of the country it is customary to sow the seed for early cabbage in September, and winter the plants over in cold frames. This method is impracticable in the extreme Northern states, and the best plan to follow in such sections is that of sowing the seed in greenhouses or hotbeds from the middle to the last of February. As the plants need room they are transplanted so as not to be crowded. If they are kept growing freely they will be large enough to transplant to the open ground by the first of April.

Setting the Plants.—Cabbage plants will grow at a low temperature, and it is a great advantage to plant them out early in the spring, although the weather may be damp and cold. At this season of the year they may not show any great increase in leaf surface, but they form roots rapidly, and these are a great help in providing a vigorous growth later in the season. As a rule, early cabbage should be set out as soon as the frost is out in the spring and the ground nicely settled. It is important to set the plants deep in the ground at this season, and since the stem is the part most liable to injury from hard frosts it should be set deep enough to bring the base of the leaves below the ground. This is very important, and frequently makes the difference between success and failure in growing the early crop.

If severe weather is threatened after the plants are set out, it is a good plan to draw a hoeful of earth over each plant; for if frozen when they are covered with earth they will not be injured, and they can remain buried in the ground several days in cold weather without serious injury. The earth should be removed, however, as soon as good weather is assured. The distance between the plants will depend somewhat on the varieties to be cultivated; under ordinary conditions the large, early kinds should be set out two feet apart in rows three feet apart. This arrangement permits of horse cultivation both ways when the plants are young and one way when they are full grown.

Cultivation should commence as soon as the rows can be clearly seen, and should be repeated after each rain or at least once a week until the crop is grown. For this purpose a fine-tooth horse cultivator is the most desirable instrument, and if the work is carefully done there will be very little need of hand hoeing. It is a good plan to draw the earth slightly toward the plants when they are about half grown.

Harvesting the Crop.—Treated in this way, under ordinary conditions they will be nicely "headed up" by the first of July and ready for marketing. The season for marketing, however, will depend largely on the kinds grown. If the land is at once plowed when the crop is harvested, it can be used for growing some late crop, as late beans, spinach, or celery. By care in sowing and in selecting varieties, early cabbage may be continued till late cabbage is in the market.

Retarding the heading of cabbages may be accomplished by starting the roots on one side of the head or by slightly pulling the plant so as to break some of the roots. This is very important some seasons, as it is not uncommon to find the market over-stocked with this vegetable just as the crop is full grown, and if the plants are allowed to remain growing when once a hard head is formed they are very sure to burst and be spoiled. By starting the roots a little, the growth is checked and the heads may be kept from spoiling for a week or more.

Late cabbage is a term generally given to cabbage grown from seed sown in the open ground. It may be ready for use in September or in the late autumn and be kept all winter.

Soil.—Any land that will produce a good crop of corn is in good condition for late cabbage, but the richer the land the better the chances of success. Less manure is required for late than for early cabbage. Late cabbage is generally raised by sowing the seed in hills, or by sowing it in a seed bed and setting the plants in the field when of sufficient size. Each of these methods has its advantages and will be referred to separately farther on.

Sowing Cabbage Seed.—Late cabbage may be raised by sowing the seed in a seed bed in the spring, in rows twelve inches apart, and when the plants are large enough transplanting them to the field where they are to be grown. This is the common way of growing cabbage. Its advantages are that the plants may be set out on land that has grown some early crop, as peas, or on sod land after cutting the hay. It also insures having the plants all together in a small space, where they can be easily cultivated and guarded when they are young and most liable to serious injury from cut-worms, flea beetles, and other insects and from dry weather. It has the disadvantage of requiring the plants to be moved during the dry weather of early summer, when they are very likely to fail from lack of water in the soil.

Sowing the seed of cabbage in the field where the plants are to mature and then thinning out to one plant to a hill, has the advantage of not requiring the transplanting of the plants during dry weather, and as the plants are not set back by transplanting they mature in a shorter time than transplanted ones. This makes it practicable to sow the seed later than when the plants are to be removed, and is sometimes an advantage. It has the disadvantage, however, of having the plants scattered over a large area when they are small and liable to attack by insect enemies and they are more difficult to cultivate than when in a seed bed. The thinnings from the land where seed is sown in the hill may be set elsewhere.

Raising Cabbage by Transplanting.—If the plants are to be raised in a seed bed and then transplanted to the open ground, the seed of such varieties as Late Flat Dutch should be sown about the 10th of May; but if Fotler's Improved Brunswick or other second early kind is to be grown, the seed should not be sown until at least ten days later; and such large, early-heading varieties as Early Summer may be successfully raised for winter use when their seed is sown as late as the first of June. In any case the plants should be ready to set out by the last of June, when they should be carefully transplanted. The land should be thoroughly pulverized and marked out three feet apart each way, unless it is to be manured in the hills, when it should be furrowed out one way and marked the other way. The plants should be set at the intersections of the marks, but it is not a good plan to set them on top of the manure, but rather to put them a little to one side of it. This is especially important if the manure is not well rotted. The cultivation and after treatment are the same for late as for early cabbage.

Cabbage from Seed Sown in the Hill.—If the seed is to be sown in hills, the land should be treated as recommended when the plants are to be transplanted. It is generally necessary for success to have the soil moist when the seed is sown. After the land is marked out, seven or eight seeds should be sown at each intersection, covered with about half an inch of soil, and then pressed down with the sole of the foot. The plants generally come up inside of a week, and should be hand-hoed at once, and, when large enough, cultivated with a horse implement. When big enough to stand alone, take out all but one plant from each hill and treat as directed for those that have been transplanted.

Harvesting late cabbage may be done by selling directly from the field or by storing for marketing during the winter. If the heads are nearly ready to burst they cannot be kept long and should be disposed of at once. There is generally a good demand in the late autumn for this vegetable on the general market and also by the pickling factories for making sauerkraut. Cabbages will stand ten degrees or more of frost, but severe freezing is very injurious; they are seldom injured by frost unless the stump is frozen solid. If there is danger of severe freezing before the crop can be marketed or stored, it is a good plan to pull the plants and put them into piles, with the stumps inside, and cover the whole with straw litter. Piled and covered this way they may be left in the field until severe freezing weather, and will generally be safe in such a condition in the North until the first of December. At harvesting there may be some heads that are quite too loose for marketing, and such cabbage will often improve very much if stored as recommended for seed cabbage.

Storing Cabbage.—In order to have cabbages keep well far into the winter, they must not be headed very solid when gathered, but should be a trifle soft; but there is quite a difference in the keeping qualities of the different varieties. If late varieties are sown too early, they will

Fig. 79. Cabbage pitted for winter.

not keep well; and if early varieties are sown late so as to be in good keeping condition when harvested, they often keep very well.

In order to store cabbages successfully, they must be kept cold and moist but never allowed to get warm or wet. Providing the cabbage is in good condition for storing, it will generally keep until spring if the heads are set together, in a trench, roots up, and covered with from six inches to a foot of soil and mulch enough to prevent hard freezing. If they are frozen while buried and are thawed out in the ground, they are seldom seriously injured. In sections of severe winters, however, a better

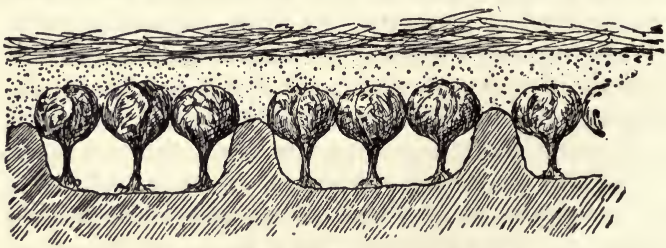

Fig. 80. Seed cabbage pitted for winter.

plan is to keep them in a cold, damp cellar, stored in bins about four feet wide so as to allow a circulation of air through them. For commercial purposes, it is a good plan to build store houses half in and half out of the ground. In a small way they may be kept by burying the heads in sand in a cellar, or a few cabbages for home use may be heeled in by the roots in the cellar; but it should be borne in mind that decaying cabbage is dangerous material to have under a dwelling house, and it should not be permitted under any circumstances. In storing cabbage the loose, outside leaves should be removed and the stumps always left on, except when they are to be stored in bins.

Cabbage seed is a somewhat difficult crop to raise in this (Minnesota) section, the trouble being in keeping the plants over winter. It may be done, however, if care is used. For this purpose the heads should not be permitted to get very hard; they should be gathered before the stumps have been frozen and be set close together, heads up, in a trench and covered with about a foot of soil and mulching enough to prevent severe freezing. Cabbage seed may be raised from the stumps after the heads are cut off, and this is a very simple matter, as the stumps can be buried like turnips or even kept in bins, providing they are covered with earth and kept cold; but such seed is not desirable, as the evidence seems to show that there is a tendency to increase the length of the stump at the expense of the head under such treatment. It is generally agreed among our best seed growers that cabbage seed should be saved from the terminal buds of the stem, which are in the cabbage head. Providing the seed cabbages are successfully wintered over, they should then be planted about the 1st of May about three feet apart in deep furrows four feet apart. Sometimes the seed stalk cannot burst through the head leaves, and it is a good plan where the outer leaves are very thick and tough to cut through the outside leaves on the top of the head a little so as to allow it to push through.

The seed is gathered branch by branch as the pods begin to turn yellow, and it generally takes several cuttings to harvest the seed pods. These are dried in a room having a tight floor and the seed is then threshed out.

Varieties.—For very early use the Early Jersey Wakefield is perhaps the most popular variety, but the head is quite small. For second early the Early Summer is perhaps the best and is generally more profitable than other early

Fig. 81. Three standard varieties of cabbage: A late variety (on the left), Red Pickling (middle), and Savoy.

kinds, since the head is of good size. The Early Winningstadt is a very desirable variety, forming very solid heads. It is the most reliable of all varieties for early or late use in unfavorable situations. Fotler's Improved Brunswick is a good variety for second early use or for winter use and is the earliest of the large-heading kinds.

Flat Dutch and Stone Mason are desirable winter sorts and are good keepers. The best red cabbage is perhaps the Mammoth Red Rock. The Savoys are of better quality than the ordinary drumheads but do not produce so heavily. They are desirable for home use. The best of this class is the American Drumhead Savoy.

Sauerkraut.—The following recipe for sauerkraut is a very excellent one: Slice cabbage fine in a slaw cutter; line the bottom and sides of an oaken barrel or keg with cabbage leaves, put in a layer of the sliced cabbage about six inches in depth, sprinkle lightly with salt, and pound with a wooden beetle until the cabbage is a compact mass; add another layer of cabbage, etc., repeating the operation, pounding well each layer until the barrel is full to within six inches of the top; cover with leaves, then a cloth, next cut a board to fit loosely on the inside of the barrel and kept well down with a heavy weight. If the brine has not raised within two days, add enough water with just salt enough to taste to cover the cabbage; examine every two days and add water as before, until brine rises and scum forms. Then lift off the cloth carefully so the scum may adhere, wash well in several cold waters, wring dry, and replace, repeating this operation as the scum rises, at first every other day, and then once a week, until the acetous fermentation ceases, which will take three to six weeks. Up to this time keep warm in the kitchen, and then remove to a dry, good cellar, unless made early in the fall, when it may be at once set in the pantry or cellar. One pint of salt to a full barrel of cabbage is a good proportion; some also sprinkle in whole black pepper.

Or, to keep until summer: In April squeeze out of brine and pack solid with the hands in a stone jar, with the bottom lightly sprinkled with salt; make brine enough to cover the kraut well in the proportion of a tablespoon of salt to a quart of water; boil, skim, cool, and pour over; cover with cloth, then a plate, weight, and another cloth tied closely down; keep in a cool place, and it will be good as late as June. Neither pound or salt the cabbage too much; watch closely and keep clear from scum for good sauerkraut.—Buckeye Cook Book.

Insects.—The insects injurious to the cabbage are the flea beetle, cabbage worms, cut-worms, and flea, for treatment of which see chapter on insects.

Diseases.—There are very few diseases that seriously injure the cabbage. The most common is clubroot, also called clubfoot. The life history of this disease is not known. It attacks the roots of cabbage, cauliflower, turnips, and other plants of the same family, causing them to form large, irregular swellings. The plant is checked in growth and often dies from the effects of the disease. This is not yet a common disease in the West, but in some of the Eastern and Middle states it is very common. The best way of avoiding it is to not use the same land for cabbage or similar crop without at least three years intervening, during which time it is preferable to have the land in grass or clover. This disease is also transmitted by pepper cress, shepherd's purse, candytuft, and similar plants. This disease may also be distributed in manure from animals fed on diseased plants.

Black rot of cabbage is a disease that has not attracted much attention until the last few years, but has during that time caused much damage to cabbage and cauliflower.

The first indication of this disease is upon the outer leaves of the plant, which turn yellow and die in spots, usually near the margins. Such leaves are also apt to wilt, and careful examination will show that the veins in and near the dead areas are blackened. These spots enlarge and gradually involve the whole leaf, from which it passes to the stem and to the rest of the plant, causing it to rot. The dark-colored veins in the freshly cut stem and leaves are the best indications of this disease, and are its characteristic marks.

Cabbage that is even slightly affected will not keep, for this rot spreads rapidly in stored cabbage; and in selecting cabbage for storage, the stems and outer leaves should be examined for the blackened vein so characteristic of this disease.

The germs of the disease may pass the winter in the soil and reinfect cabbage, cauliflower, turnips, or similar crops and even such nearly allied weeds as pepper cress and shepherd's purse the following season. If diseased cabbage is fed to stock the disease may be distributed with the manure.

Remedial Measures.—In view of the above facts, it seems reasonable to take the following precautions: (1) Do not plant cabbage a second year on land where the disease is observed without several years intervening, during which no nearly allied crop has been grown on it. The seed bed should also be made in new soil each year, as the plants may become diseased when very young. (2) Do not use manure for cabbage crops from animals that have been fed uncooked diseased cabbage. (3) The disease may be spread by insects which fly from one plant to another; hence these insects should be kept in check as much as possible. (4) When the disease appears the field should be gone over systematically and all diseased leaves removed and destroyed as soon as they appear. If the disease has entered the stem the whole plant should be destroyed. This destruction should consist in burning or deep burial. (5) Since this disease may be continued on wild mustard, pepper cress, shepherd's purse, and other allied plants, these plants should be carefully kept out of land that has been once infested if it is intended for cabbage.

BRUSSELS SPROUTS (*Brassica oleracea*)

Description.—Native of Europe. A biennial. This is one of the many variations which the cabbage has taken on under cultivation. In this case where the head of the cabbage is ordinarily found there are loose green leaves and seldom a head. The stem is generally two feet or more high, with leaves, and at the base of each leaf is a small cabbage which seldom attains a diameter of over two inches. These little cabbages are the parts eaten; they are much more delicate than the common cabbage and are highly esteemed by many. The plant requires the same treatment as cabbage, except that the plants can be grown nearer together. While easily grown it is doubtful about its becoming a popular vegetable, since in most of our markets very little attention is paid to quality, and the common cabbage will probably continue to take the place of this vegetable on most tables. The variety most esteemed is known as Dwarf Brussels sprouts.

Fig. 82. Brussels sprouts.

CAULIFLOWER (*Brassica oleracea*)

Description.—Native of Europe. A biennial. Cauliflower is a form of cabbage in which the inflorescence becomes fleshy and distorted. It is, however, considered much more delicate than cabbage, and brings a higher price. It is grown in much the same manner as cabbage; the plants, however, are not as hardy in resisting cold weather as cabbage, are more sensitive to adverse conditions, and should have more manure in the soil. As soon as the head commences to form, the outside leaves of the plant should be drawn together over the head so as

Fig. 83. Snowball cauliflower.

to keep the sunlight away from it. Treated in this way the heads will be nearly snow white, while if not protected they become brown in color and are not as salable. The crop ripens somewhat irregularly. When danger of hard frost is apparent the immature heads should be pulled with roots and leaves and be planted out in a cold cellar or cold frame, where many of them will form good, salable heads.

The insect enemies are the same as those of the cabbage.

Fig. 84. Cauliflower plant with leaves tied together to keep the sunlight off the head. This should be done as soon as the head can be seen, and the leaves should remain tied until the head is harvested.

Varieties.—There are many varieties, of which, perhaps, the most desirable are the Snowball and the Early Dwarf Erfurt.

KALE, OR BORECOLE
(*Brassica oleracea* var.)

Description.— Native of Europe and Asia. Annual or biennial. The seed is like that of the cabbage or kohl-rabi. Under this head is grouped a number of vegetables closely related to cabbage and kohl-rabi, and are used for greens. None of them are sufficiently hardy in the extreme north to stand out over winter. They are here cultivated in the same manner as turnips. In sections where the winters are mild, some of them are esteemed for planting in autumn for early spring use.

Fig. 85. Dwarf Purple kale.

KOHL-RABI (*Brassica oleracea* var.)

Description.—Kohl-rabi has been derived from a plant nearly allied to the cabbage, and its seed resembles cabbage seed. Its pecularity is its swollen stem just above the ground, which is used for the same purpose and grown in the same general way as a turnip. It is more highly esteemed than turnips for early summer use where well known. Like turnips it should be sown where it is to mature and be used when young and tender. It may be stored in winter like turnips.

Fig. 86. Kohl-rabi.

Varieties. — There are small, tender varieties especially designed for table use, and others that grow to large size and are valuable for feeding to stock. Two of the best for table use are the White Vienna and the Purple Vienna.

TURNIP (*Brassica napus*) AND RUTABAGA, OR SWEDISH TURNIP (*Brassica campestris*)

Description.—Native of Europe or Asia. Biennials. They are cultivated for their swollen, fleshy roots. The varieties of turnip and rutabaga vary much in form, size, and color of the skin. The flesh is white or yellow, and pungent or slightly acid. There are more differences in the varieties of the turnip than of the rutabaga. The flower stalks are produced the second year and bear a large number of yellow flowers. The seeds are smooth and round like the seed of the cabbage and cauliflower and are in similarly shaped pods.

Turnip.—The turnip is essentially a cold weather plant and does best when most of its growth is made during the autumn. It is grown to some extent in the spring, but there is very little call for it until cool weather.

Culture.—The turnip needs to be grown very rapidly to have the best quality. The best soil for it is a friable, rich, sandy loam, free from fresh manure. Sod land that

Fig. 87. White Strap Leaf turnip.

has been recently broken up is excellent for turnips; but on old land, i. e., that which has been cultivated for several years, or where there is fresh manure, the roots are often wormy. When grown for early use some quick-maturing kinds should be planted as early in the spring as the soil can be worked, in rows fifteen inches apart. The seed should be sown rather thickly and the seedlings thinned out two or three inches apart after all danger from the flea beetle has passed. (This insect is the same as that which attacks cabbage.)

Turnips grown for late use generally come in as a second crop after grain, strawberries, early potatoes, cabbage, or other crop that is off the land by the first of August, since after this time a good crop of many varieties of late turnips will mature before winter, though some of the large kinds need to be sown earlier in the season. The seed is sometimes sown broadcast just before a shower, or else it is harrowed in. It is also grown in rows about two feet apart and cultivated with a horse cultivator, or the rows may be put nearer together and a hand cultivator used.

Varieties.—Some of the best varieties of turnips are Early Flat and Extra Early Milan, for early use; Red Top Strap Leaf and White Egg or White Globe, for autumn use.

Rutabagas, also called Swedish turnips, are grown in the same manner as the common turnips, but require about four weeks longer to attain edible size, and, on this account, should be planted by the middle of June or first of July. They are grown in rows thirty inches apart and cultivated with a horse hoe. Rutabagas are sometimes grown in beds and then transplanted, but this is seldom, if ever, done with turnips.

Fig. 88. Rutabaga.

The seeds of both turnips and rutabagas are so smooth and fine that they are generally sown too thick. Mixing the seed with flour is a good way to prevent its running too rapidly through the seed sower. The crop should be allowed to stay in the ground until the approach of severe cold weather. They will stand some little freezing without injury, but will not live in the soil over winter. They should be stored in frost-proof pits or cellars. In dry cellars they should be covered with a few inches of sand or other material to prevent wilting. (See directions for keeping carrots.)

Varieties.—Improved Purple Top Swede and White Rock are both excellent varieties of rutabagas.

HORSE-RADISH (*Nasturtium armoracia*)

Description.—Native of Europe. A perennial. Flowers white and small, in long clusters; seed vessels small, rounded and almost always barren. Propagated by cuttings of the roots.

Cultivation.—This plant thrives in deep, moist soil, but will grow in almost any situation, and is very hardy. It is customary to let it remain in some neglected corner, where it kills out everything else; and though treated in this way it yields sufficient roots for home use, the roots are so crowded that they are scarcely salable. When grown as a market crop it is planted anew each year. Straight pieces of roots six or eight inches long, called "sets," are planted early in the spring about twelve inches apart in rows two feet apart. The roots must be set right end uppermost or they will not grow smooth and straight. An iron bar is the most convenient tool for planting the sets. The tops of the sets should be about two inches below the surface.

It is customary to grow horse-radish as a second crop after peas or cabbage, by setting the roots between the the rows of the first crop and cultivating the soil without regard to them until the first crop is harvested. It does not seem to hurt horse-radish sets much if they are cut off a few times in cultivating early in the season. When the first crop is gathered the land is thoroughly cultivated, and the horse-radish plants given good care. This plant makes its greatest growth in autumn and is dug on the approach of winter or can be left until spring. It must never be left two years on the same land, or else great labor will be required to get rid of it, and the roots will be so crooked as to be almost unsalable.

Horse-radish is used almost entirely after grinding or grating the roots and mixing with vinegar. It will keep for any length of time when thus prepared and kept in air-tight packages. It is also ground and dried, and the young leaves are sometimes used for greens. The demand is limited, though considerable quantities are sold each year. Under some conditions it is a paying crop, but the business is very liable to be overdone. There are no varieties.

WATER CRESS (*Nasturtium officinale*)

Description.—Native of Europe. A perennial. This is an aquatic plant, with long stems which readily take root in moist soil or water. It is esteemed for use as a salad on account of its pleasant pungent flavor. Leaves are compound, with roundish divisions; flowers small white, in terminal spikes; seeds, usually few, very fine, in slightly curved pods.

Culture.—It can only be cultivated successfully in moist situations and generally does best along the edges of streams, where it grows partially in the water. It may, however, be grown successfully in any moist soil, even in a greenhouse. It is very hardy, but for best results should be covered with water during winter. Most of the supply for our markets comes from along the courses of natural streams. In Europe, trenches from 16 to 20 feet wide for growing water cress are often excavated, into which running water may be turned at pleasure. In the bottom of these trenches the roots of the cress are planted. The water is then let in, and the plants are not interfered with until they have grown strong enough to yield a crop of leaves. It is often practicable to make narrow beds for this purpose about springs or slow running streams.

CRESS, OR PEPPER GRASS (*Lepidium sativum*)

Native of Persia. An annual. An early vegetable used as a salad and for garnishing, and of the easiest culture. It should be sown very early in the spring in the hotbed or outdoors in rows one foot or less apart. As it quickly runs to seed, a succession of sowings should be made every eight or ten days. It is in demand only in the early spring or in winter. It can easily be grown in a window box in a dwelling house. Flowers are white and small; seeds comparatively large.

RADISHES (*Raphanus sativus*)

Description.—Probably a native of Asia. Annual or, in the case of the winter radish, biennial. The flower stalks are branched, about three feet high, and have white or lilac-colored flowers, but never yellow. The seed is roundish or oval, but somewhat flattened, and much larger than cabbage or turnip seed and much more variable in size. Some recent experiments show that the large radish seeds germinate better and produce marketable roots sooner and more uniform in shape than small seed.

Culture.—The radish is a vegetable of very easy culture. The roots of some kinds reach edible size in three weeks when grown in best conditions, and are a favorite vegetable of early spring. It is a common practice to sow the seed of early kinds in hotbeds between rows of lettuce, and outdoors between, or in, the rows of beets, carrots, parsnips, etc. They will grow in almost any soil, but new land is best for them. The seed may be sown as soon as the ground can be worked in the spring, and if sowings are made once every two weeks thereafter a succession of tender roots may be had.

Fig. 89. White Strasburg radish.

Winter radishes are grown and stored in the same manner and fully as easily as turnips. The seed is sown in June or July and the roots gathered in autumn and stored in cellars or pitted outdoors. They keep very well. Winter radishes closely resemble the early kinds in quality, but are firmer in texture.

Insect Enemies.—The cabbage flea beetle affects the young radish plants in the late spring and summer. (See chapter on insects for remedies.) The roots are sometimes infested with maggots, but these are seldom troublesome except where fresh manure is used or in land where radishes have been grown for several years. It is best not to manure the land for radishes but to use rich soil that has been put in good order by some previous crop.

Varieties.—There are many kinds, differing from one another in color, form, size, time of maturity, and taste. They are generally divided into early or forcing varieties, summer and autumn varieties, and winter kinds. A few of each are here mentioned:—

French Breakfast.—One of the best very early radishes for the market, but small. It remains in good condition for only a short time, consequently is not desirable for the home garden.

Early White Tip Scarlet Turnip Shaped.—A handsome round, early, popular radish, maturing very quickly.

Fig. 90. French Breakfast radish.

Early Deep Scarlet. —Very early, round and of deep scarlet color.

Long Scarlet Short Top. — A well known desirable early kind having long, scarlet roots.

White Strasburg. — One of the finest half-long kinds for summer use. Grows to good size; white and tender.

Rose.—The most popular of the winter sorts; skin pink.

Black Spanish.—Skin very black; flesh white, firm, tender, but very pungent. A good winter sort.

THE CLOVER FAMILY (Order Leguminosae)

The Clover Family is made up of trees, shrubs, and herbs which with few exceptions have a butterfly-shaped corolla, ten stamens, nine of which are generally grown together. The fruit is known as a legume and is a pod that opens like the pea or bean pods. The leaves are alternate, chiefly compound, and have stipules. Besides the beans ana peas, whose cultural directions are here given, the following are members of this family: clovers, vetch, alfalfa, and lupine, among farm crops, and the common locust, Kentucky coffee tree, honey locust, and yellowwood, among trees.

BEANS (Phaseolus)

Description.—An annual. The common beans in this country are natives of the warmer parts of South America. They are sometimes referred to as kidney or French beans (*P. vulgaris*). Besides these, the Lima beans (*P. lunatus*) are cultivated to a limited extent. The common broad bean of Europe is an entirely different vegetable from the kinds generally grown here and is not sufficiently prolific in the North to make it worthy of cultivation. There are many varieties of beans, and the varieties of each species readily cross together, the flowers being especially adapted to crossing. They vary from one another in many particulars; some are low, bushy, and erect, while others are twining and have stems that grow ten or more feet in a season.

There are many gradations between these extremes, as well as in size, color, and shape of seed and plant. The twining-stem kinds always twine from right to left around any support they can lay hold of. Horticulturally, beans are divided into the bush and the pole varieties. Under the first class are included all the field varieties that are grown to be used as shelled beans and some snap and string beans. They have stout, erect or slightly running stems. Under pole beans are classed all the kinds that have twining stems and which are benefited by having support of some kind. There are, however, dwarf bunch beans having the same general features as the pole kinds except the tall stem.

While this division is by no means distinct, yet the methods of cultivation adapted to each growth are different. All beans are quite tender and should not be planted until the soil is warm and all danger of frost is over. They are sown for early use about the time for general corn planting. For the main crop they should be planted about the first of June.

Fig. 91. Bush bean.

Bush Beans.—These are very easily grown and are adapted to a great variety of purposes. For a field crop on a large scale, the seed is generally sown with a horse drill or with a hand garden drill in rows three feet apart. It is sometimes best to mark out the land first and then follow with the drill in the marks. Seed should be sown two or three inches deep. On a smaller scale, the land may be furrowed out with a one-horse plow or with a wheel hoe and the seed sowed by hand. After culture consists in keeping the land well cultivated with a horse hoe and free from weeds. Varieties of dwarf beans for use in a green state, such as string or snap beans, may be sown at any time from the middle of May to the first of August and with good prospects of a good crop of green pods even at the latter date. Some kinds have edible pods in less than six weeks after the seed is sown.

Harvesting Beans.—For use in a green state, the pods of some kinds of beans are picked as soon as large enough to use and when they are tender and fresh; in other cases the beans are used when still fresh, but not until they are large enough to shell from the pods. Field beans are harvested by being pulled by hand or gathered with a bean gatherer when they are ripe, laid in rows until dry enough for threshing, then threshed at once or stored for threshing later on. Great care should be taken in storing the pods to prevent molding of the beans, and in threshing not to break the beans. In a small way beans may be threshed out by hand, but on a large scale any common threshing machine may be used, providing suitable changes are made in it so it will not break the beans.

Varieties of Bush Beans.—There are many varieties of bush beans having desirable qualities, but only a few of the most valuable are mentioned here:—

Field Beans.—White Marrow, Burlingame Medium, Navy, and Snowflake.

Waxen Podded Beans.—Dwarf Golden Wax and Dwarf Black Wax.

Shell and String Beans.—Yellow Six Weeks, Early Mohawk, Cranberry, and Dwarf Horticultural.

Japanese, Soy, or Soja Beans.—These are easily grown, but on account of their inferior quality are not much used here.

Dwarf Lima beans are highly esteemed by those who know them, and although smaller in size than the pole Limas are supplanting them in some sections and are coming into quite general use, on account of their being more certain to mature well and requiring less labor in cultivation. They require the same methods of cultivation as other dwarf beans but should not be planted until the land is thoroughly warmed.


Fig. 92. Dwarf Lima beans.

The best varieties are known as Henderson's Dwarf, Burpee's Dwarf, Jackson Wonder (black spotted), and Kumerle Dwarf Lima. The common dwarf shell beans are early, productive, and good, but not as rich in quality as the varieties named.

Pole Beans. — The twining varieties of beans are little grown in this section, as the improved dwarf kinds take their place to a great extent. Tall Lima beans, however, are highly esteemed by many, and the dwarf varieties of this class are not as desirable as the pole kinds. There is also a demand for such shell beans as the pole Horticultural, Cranberry, and Case-knife varieties. Pole beans require stronger land than do the dwarf kinds.

The ordinary way of growing pole beans is to set poles six feet long in hills four feet apart each way. It is customary to put a shovelful of good composted or rotted manure in each hill if the land is poor. Seed should not be planted till the ground is quite warm; the pole varieties are more particular in this respect than the dwarf kinds. About six seeds should be planted two or three inches deep around each pole. In the case of Lima beans the general belief is that the beans should be planted edge-ways with the eye downwards, but good results are often obtained by sowing the seeds without regard to this matter. This latter method is customary in sowing the dwarf Lima, and some who sow the large Lima beans in furrows and train them to trellises pay no regard to the position of the seed in the soil, but sow an abundance of seed so as to be sure of a good stand.

Lima beans are generally shelled by hand when fresh but full grown, and are sold by the quart. In warm climates they are sold in large quantities after being dried. The Cranberry and Horticultural kinds are generally sold in the pod. As soon as the seedlings commence to "run" it is customary to assist them in getting started, and some seasons it is necessary to tie the Lima beans to the poles until they are well started. Lima beans require as extra warm location and soil.

Beans may be transplanted if removed with much care when the soil is moist. Some very successful gardeners find that it pays them to start their pole Lima beans on pieces of sod or in pots or boxes in hotbeds, and in this way they advance the period of ripening two weeks or more. This a very desirable practice with pole Lima beans in the North since the short season often fails to mature much of the crop when the seed is planted in the open ground. The varieties of pole Lima beans best adapted to the Minnesota section are probably the Large Lima and Dreer's Lima; both of these are of fine quality and are productive. The small Lima or Sieva bean is earlier than those mentioned, but of inferior quality.

Preserving Beans in Salt.—String beans are easily preserved in salt for winter use, using about seven pounds to the bushel of pods. In doing this the fresh, tender pods are put at once into the brine as they come from the field.

Fig. 93. Anthracnose of bean pod.

When wanted for use, they should be freshened out and cooked in the ordinary way. They are very good, and are nearly as desirable as the best canned beans.

Diseases and Insects.—Beans are quite free from the attacks of any injurious insects or diseases. Anthracnose of the bean (*Gloeosporium lindemuthianum*) shows itself by black spots on the stems or pods or both. It is sometimes very injurious in moist weather, but only in the occasional years have we anything to fear from it. It is not generally considered profitable to use any of the fungicides such as Bordeaux mixture,which would readily prevent it. Beans grown in locations where there is a good circulation of air are less liable to injury than those not so situated.

PEAS (*Pisum sativum*)

Description.—The pea is an annual plant of uncertain origin, but probably a native of central Europe. The flowers are either white or violet colored, but the most desirable garden kinds, almost without exception, bear white flowers.

Varieties of peas are divided into three classes, those having wrinkled seed, those having round, small seed, and those having edible pods. Wrinkled-seed varieties do not germinate as well as the smooth-skinned or round sorts, nor do their germinating powers last as long, nor are they as hardy in resisting the adverse conditions of early spring. On account of the latter reason, gardeners plant the round seed first in the spring, and do not plant the wrinkled kinds until the soil is in the best condition and somewhat warm. The wrinkled kinds are better in quality than the round and smooth varieties. Peas having edible pods are not popular in this country, probably because of the ease with which string beans are grown.

Culture.—Peas may be grown successfully in almost any good soil; they even do well on rather poor soil. The kinds having smooth seeds should be planted as soon as the ground can be worked in the spring—even a hard freeze does not hurt the plants as they are coming out of the ground, and they will stand considerable frost when well up. The distances between the rows and the seeds in the row depend somewhat on the kinds grown. Some kinds branch out far more than others, and, consequently need more room in the row. They also vary in length of stem from a few inches to six or seven feet. The tall kinds require the rows to be five or six feet apart, while dwarf varieties are generally planted in rows thirty inches to three feet apart. The growing of tall kinds is confined mostly to private gardens, where it is customary to use brush or other material in the rows for support. Formerly among tall

Fig. 94. Nott's Excelsior pea.

varieties were those far excelling in quality anything found among those of a dwarf habit, but recent introductions of the latter kinds have shown a great improvement in quality, until now the dwarf sorts are generally grown, even by the most fastidious.

In common practice the seed is sown about four inches deep, in rows three feet apart, putting about ten seeds to each foot of row. It is best to sow plenty of seed in order to secure a good stand. The land should be well cultivated between the rows. Unleached wood ashes or some other fertilizer rich in potash and phosphoric acid is most beneficial for this crop. As it belongs to the leguminous section of plants, it is a nitrogen-gatherer and, consequently, does not need much nitrogen in the soil. Early peas as generally grown are out of the way in time to allow the land to be used for late cabbage or string beans.

When it is desired to extend the season of table peas, successive sowings should be made at intervals of two weeks, up to the tenth of June. During the summer the vines are too liable to mildew to make late spring planting successful. The pea is distinctively a cool weather plant, and on this account it will often do well when sown in the latter part of summer for use in autumn.

The canning of peas is an important industry in some sections and could be more readily introduced into other sections to advantage. In sowing peas for canneries it is the practice in some sections to sow them with a common grain drill and to harvest with machinery. The Alaska is the variety very largely grown for canning. Its pods mature almost at one time, which is a desirable character. They are shelled by machinery and are graded into various sizes by passing over sieves. Gross returns for peas vary with the market and the variety from $25 to $100 per acre.

Varieties.—Of the many varieties only a few of the best are mentioned here. For very early use, almost every seedman has a strain of smooth, round peas which he sends out under his own peculiar name. The early sorts are generally derived from the old Daniel O'Rourke, and among them are varieties known as the First and Best, Earliest of All, Alaska, and Improved Extra Early. As a rule these should be used for first planting only, to be followed by plantings of the wrinkled sorts.

American Wonder is a very dwarf early pea of unsurpassed quality and very hardy for a wrinkled sort. A rich soil and extra cultivation are required to get the best results from it. If only one variety is to be grown, this is perhaps the best to plant.

Gradus.—An early, large-podded, wrinkled pea of excellent quality and a good yielder. The vines grow about three feet high.

Stratagem.—Very productive and justly very popular, having remarkably large pods filled with rich, sweet peas. It does better on light than on heavy soils.

Marrowfat.—Among the most popular of the old varieties.

Champion of England.—A tall-growing, popular sort, of best quality, that does best when supported by brush or wire netting. Late.

Telephone.—Of excellent quality, pods and seeds large. One of the most productive, and consequently very popular. Late.

Thomas Laxton.—Ripens a few days later than Gradus, has large pods, and peas of good quality.

Nott's Excelsior.—An early dwarf variety growing about fourteen inches high. It is an improvement over the American Gradus in that it has larger pods and is more prolific.

THE MALLOW FAMILY (Order Malvaceae)

The Mallow Family is composed of plants having flowers with numerous stamens which have their filaments grown together and attached to the base of the petals. The petals are twisted together in the bud. Seeds are kidney-shaped. Herbs or shrubs mucilaginous with very tough, fibrous bark; none of them are poisonous. Okra is the only plant of this family that is frequently grown in gardens, but the common cotton plant also belongs here, as well as the Abutilon mallow, Hibiscus, Althaea, and hollyhock of our gardens.

OKRA (*Hibiscus esculentus*)

Description.—Native of South America. An annual. The seed is round and of medium size. It is cultivated for its green seed-pods, which are highly esteemed for soup. It is little grown except in the South. It is of the easiest culture. The seed should be sown about two inches apart in rows two feet apart and in rich, warm soil, at about the time for planting beans. The pods are produced abundantly but are perhaps not as tender when grown in our dry atmosphere as they are in the South. The flowers are large, yellow, and very pretty.

Fig. 95. Dwarf okra.

The varieties known as Dwarf Green and Long Green are best for northern climates.

THE PARSNIP FAMILY (Order Umbelliferae)

The Parsnip Family is made up of herbaceous plants some of which are aromatic and others are acid-narcotic poisons. The flowers are small and generally arranged in compound umbels; no calyx, but instead often have five minute teeth; five petals, five stamens, and two pistils. The dry fruit usually splits into two parts, and the seed of most species has oil tubes. The leaves are alternate and more commonly compound or decompound. Besides the parsnip, parsley, carrot, and celery, whose cultural directions are here given, the family includes dill, anise, caraway, coriander, and fennel, which are described under the head of garden herbs.

Fig. 96. Parsnip plant in flower.

PARSNIPS (*Pastinaca sativa*)

Description.—Native of Europe. A biennial. Cultivated for its long, tender root. Seeds are light brown in color, flat, and marked with five raised lines or ridges. The seed stalks are three to five feet high and have large umbels of greenish flowers.

Culture.—The parsnip is grown in the same manner as the carrot, but is rather more particular about the soil on which it grows. Then, too, in manuring the land for this crop, it is important to use only manure which is well rotted, as the application of fresh manure seems to encourage the formation of side roots. Also on hard land, there is often a tendency for the roots to form side roots, and, as what is desired is a rather thick tap root, side roots are to be avoided. It is important to sow the seed early and quite thick, thinning out later in order to be sure of having a good stand of plants. The seed germinates rather slowly, and it is often an advantage to sow a few radish seed with the parsnips. This is a good plan on land that bakes easily.

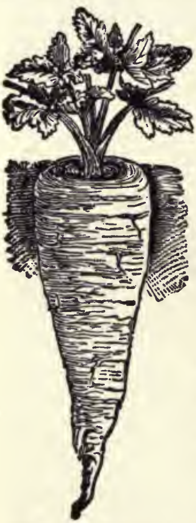

Fig. 97. Hollow Crown parsnip.

Parsnips are a very hardy crop, and may be left in the ground until late autumn or even over winter. In fact, many believe that freezing parsnips in the ground improves their quality. They may be safely pitted outdoors by putting them in heaps, covering with a few inches of hay or straw and then a foot of earth. Treated in this way, they can be taken out at any time during the winter or early spring. It is not advisable to leave the crop in the ground over winter, since it cannot then be dug until the frost is out of the ground in the spring, by which time the demand for parsnips will have considerably lessened. If kept in an ordinary cellar, they should be covered with earth or sand to prevent wilting.

In marketing the parsnip, it is often customary, after trimming off all side shoots, to sell them by the basket without washing. A far better and more equitable plan is to sell them by weight. In some of the best markets, the roots, after being carefully washed and trimmed, are packed evenly in boxes, sixteen inches square and eight inches deep, which holds just a bushel. Packed in this way, they present a very neat appearance.

Varieties.—The Hollow Crown, or Student parsnip, is the best kind to grow for table use.

Turnip Rooted parsnip, which is short and round, is used to some extent. It is a good form on light soils, but for rich land the Hollow Crown is to be preferred.

PARSLEY (*Carum petroselinum*)

Description.—Native of Sardinia. A biennial. The leaves of some varieties of this plant are used in a fresh state for garnishing and seasoning, and in the case of a few

Fig. 98. **Fine curled parsley.**

kinds the fleshy roots are used. In habit of growth parsley resembles the parsnip, to which it is closely related. The leaves, however, are variously cut and divided. A few varieties are grown for their fleshy roots.

Culture.—Parsley is grown in much the same manner as the parsnip, and, like it, its seed germinates rather slowly. The seed is often sown for winter and early spring use in greenhouses and hotbeds. The leaves may be used as soon as large enough. The roots may be taken up in autumn and grown in a greenhouse or in a box in a sunny window for a winter supply. The demand is quite limited. It is sold in small bunches and may be found in the larger markets at any season of the year. It seldom comes through our winters safely when left exposed outdoors, but sometimes does so when well protected.

The varieties commonly grown are the Double Curled and Fine Leaved, either of which makes a border that is pretty enough for a flower garden, and it is often used as an edging for small kitchen gardens.

CARROTS (*Daucus carota*)

Description.—Native of Europe. A biennial. In the wild state this root is valueless, being slender and woody, and the plant is a bad weed. Under cultivation it exhibits the widest difference in shape, size, and color. Some kinds have roots that are broader than long and extend not over two or three inches in the ground, while others attain a length of two feet, and still others may be found having the various intermediate forms between these extremes. There are also varieties having red, white, or yellow flesh. The leaves are very much divided and deeply cut. The flowers are white and crowded together in compound umbels on stalks two to five feet high.

Fig. 99. Carrot plant in flower.

The roots of the cultivated kind will stand considerable frost, but not severe freezing. Two seeds are produced by each flower; they are flat on one side and convex on the other, and are partly covered by minute bristles. The bristles are generally removed before the seed is sold. Carrots are used to some extent as a table vegetable, but they are especially valuable as a food for horses and other stock.

Cultivation.—The carrot is of the easiest culture. It requires a fine, mellow, rich, upland soil. On moist land the roots are apt to branch and are very liable to disease. The seedlings are quite delicate when they first come up and every precaution should be taken to have the land clean, so that the small seedlings will not be overrun with weeds; the surface soil should be kept loose and mellow throughout the season.

It is a good plan to sow a few radish seeds with the carrot seed so that cultivation may be commenced early, as the latter start slowly.

If the seed of the small kinds are sown very early in spring they will produce roots big enough for table use by early summer; but for the main crop the seed should be sown about the middle of May in rows fourteen inches apart. A fair crop may be expected even if the seed is not sown until the middle of June, although the dry weather which generally prevails at that time of the year is liable to prevent or retard the germination of the seed or to burn up the seedlings just as they are pushing out of the ground.

The crop is sometimes sown in rows two feet apart and cultivated with a horse implement. If the seed is good, two pounds per acre, or about fourteen seeds to the foot of row, is plenty to sow. Very thick seeding is not desirable, as the cost of thinning in such a case is considerable. It is best for the experienced grower to have all the conditions just right and then sow the seed so that little, if any, thinning will be necessary. However, the beginner will very likely find it safest to sow a large amount of seed, perhaps three pounds per acre, and thin out so that the plants will stand three inches apart in the rows. The richer the soil the more room the roots require in the row; if small roots are wanted they may be left an inch apart in the row.

The carrot requires lots of potash for its best development. Vorhees says that a yield of fifteen tons per acre will remove 153 pounds of potash, 48 pounds of nitrogen, and 27 pounds of phosphoric acid. Never apply fresh manure to the land for carrots as this will cause a large number of small roots to form instead of one large root as desired.

Gathering.—One of the greatest outlays in raising carrots is in gathering and topping the crop. The topping may be done by hand, after being plowed out; but hand labor is very costly. Some growers go over the rows and cut the tops off with a sharp hand hoe. If the tops of the roots are cut off a little no harm is done, as it does not increase the liability to rot, as in the case with beets. The roots are, perhaps most easily dug by plowing close to each row and then pulling them out by hand. For this purpose a subsoil plow is best, but any good plow will answer the purpose fairly well. If a short-rooted variety is grown, and the land is mellow, the plow may often be run so as to turn the roots out on top of the furrow slice.

Storing.—Carrots are easily kept over winter in cellars, providing they are in a temperature near the freezing point and are not too ripe when dug. If the seed has been planted too early, the roots will ripen up early in the fall and will cease to grow, and many of the leaves will turn yellow. Such roots do not keep well, but are likely to sprout badly long before spring, even if kept cold. To have the roots keep best they should be growing rapidly

Fig. 100. Harvesting long carrots and parsnips by plowing the earth away on one side and then pulling the roots by hand.

when dug. In dry cellars, it may be necessary to cover with loam or sand to prevent those on top of the bin or pile from wilting. If they are to be fed early in the winter, they may perhaps be piled in the barn and covered with chaff and straw sufficient to keep out the frost until used.

Carrot seed is raised by planting out the roots in the spring, about two feet apart, in rows four feet apart. The seed heads ripen irregularly and are gathered as they ripen and threshed when dry. The seed is generally rubbed against a sieve having a fine mesh to take the bristles off, otherwise it would be a difficult matter to sow it in a machine. Most of our seed comes from France, England, and Germany.

The forcing of carrots is carried on to a limited extent, for which purpose they may be sown between rows of radishes in the hotbed or greenhouse.

Varieties.—For very early table use the Short Scarlet is best. For general use in summer and for winter use, perhaps there are no better varieties than the Danvers

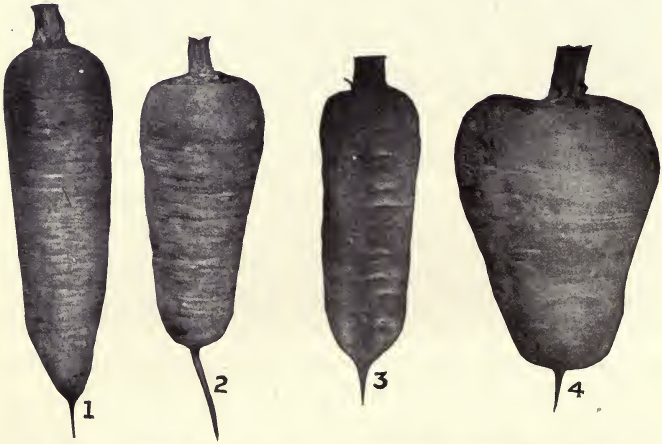

Fig. 101. Varieties of carrots: *1*, Improved Danvers Half Long; *2*, Chantenay; *3*, Nantes; *4*, Oxheart. —(*Courtesy Northrup, King & Co.*)

and the Chantenay. The Guerande Half Long, or Oxheart, is a variety that is very thick and short and yields nearly as much as the Danvers. It matures early and has the further advantage of being easily pulled by hand without any digging. The White Belgian is a large cropper, but is only of value as food for stock. Thirty tons of carrots are sometimes raised on one acre, but in ordinary practice seldom more than half that amount is raised.

CELERY (*Apium graveolens*)

Description.—Native of Europe. A biennial. The plants are grown for the fleshy leaf stalks, which are very tender when blanched; one form is also grown for the large, fleshy roots. The whole plant has a pleasant aromatic flavor. The seed stalks are branching and grow from two to three feet high, and have very small yellowish or greenish flowers in compound umbels. The seed is small, triangular, and five-ribbed, and has the characteristic aromatic flavor of the plant.

Celery is a crop that is very liable to suffer from the want of rich, nitrogenous manures and from a superabundance or a lack of moisture in the soil. On this account it should be grown on retentive yet well-drained, rich land. Well-drained bog land with the water about eighteen inches from the surface is often excellent for this purpose. Barnyard manure is the best fertilizer to apply. It may be applied up to fifty or sixty tons per acre, but ordinarily about ten tons are used. If commercial fertilizers are to be used, they should contain a large percentage of nitrogen. Nitrate of soda at the rate of 150 to 200 pounds per acre is sometimes applied.

Early Celery.—The seed for early celery is generally sown the latter part of February or early March in boxes in a greenhouse. As soon as the plants are of sufficient size to handle well, they are pricked out into other boxes or into hotbeds, where they remain until large enough for planting out, which is sometime in May. The tops of the plants should be sheared off once before they are pricked out and again before they are planted to the open ground, as this makes them stocky and helps them to recover from transplanting. If the leaves are all left on the plants when they are set out, they generally dry up and in so doing take away much moisture from the roots. The plants should be hardened off before being set out. Early celery should

Fig. 102. Celery plants. Those on the left have been transplanted, and show, in consequence, an improved root system for planting out. Those on the right were grown only in the seed bed, without transplanting, and have not as good roots for planting out. The plants with tops trimmed are ready for planting out.

be blanched by being covered with boards or with boards and straw, since the ordinary way of blanching it by banking with earth is liable to bring on disease in warm weather.

Late Celery.—The greatest demand for celery is during the autumn and winter months, and very little is marketed during the summer. The seed for autumn and winter celery is generally sown in April in the open ground, although some of our best growers sow the seed in hotbeds or cold frames early in April, before the land outdoors can be worked at all. If the seed is sown outside, a piece of fine rich land is generally selected. The seed is sown in drills about nine inches apart and one-quarter inch deep, and the soil is well firmed over it after covering. Some growers do not cover celery seed at all, except by rolling or patting it down with the back of a spade. If there is danger of the seeds drying out, some growers shade the bed with cotton cloth or with a lath screen raised about one foot from the ground and so made as to keep off about one-half the sunlight. Another plan is to cover the bed with burlap after sowing the seed, and water the seed through it; in this latter case, however, it is very important to watch carefully and remove the cloth covering as soon as the plants appear.

The seed germinates slowly. The seedlings are quite weak and should receive almost constant cultivation. The tops should be sheared off once or twice, as recommended for early celery, to make the plants stocky; they should also be thinned out so that there will not be over twenty or thirty plants to the foot of row. When sufficiently large, they should be moved to the field where they are to grow. Treated in this way, the plants will be strong and stocky; if left to crowd one another, they probably will be weak and poor. Some successful growers prefer to transplant once to narrow rows before setting in the field where the crop is to mature. This makes the final transplanting most certain by increasing the fibrous roots, but is not generally necessary, although a good plan under unfavorable conditions.

In the growing of celery plants, it will often be a good plan at the first transplanting to make up a special bed for them. This should be done as follows: A place four feet wide and of any length should be selected, the top soil to the depth of about three inches thrown off, and then rotten manure such as that which comes from spent hotbeds or similar material put in to the depth of about three inches. The top soil should then be returned and the plants set out in it. Treated in this way the young plants will develop a compact root system in the manure, and may be transplanted with a ball of roots almost as well as if they had been grown in pots. Plants grown in this way are especially desirable when transplanting must be done in a dry time, but seedbeds require much water.

Planting.—Having good plants, the next thing is to set them so as to get a good crop. It is quite a common practice in some sections to grow celery as a second crop after early peas, lettuce, cabbage, or beets. In such a case the plants, perhaps, had better not be set out until the first crop has been gathered; but where only one crop is to be grown, the plants may be set as soon as big enough. This will generally be from the middle to the latter part of June and, for latest use, the latter part of July.

The land should be thoroughly plowed, harrowed and smoothed off. Furrows six inches deep should then be made where the plants are to go, and in these about three inches of fine, well-rotted manure or compost should be placed. This manure should be thoroughly mixed with the soil and the furrow nearly filled. For mixing the manure and soil perhaps there is no better implement than a one-horse cultivator with the teeth set close together. If the land is unusually rich in plant food, there is no need of going to this trouble, but the plants may be set right after the marker. In any case the rows should be four or five feet apart for the common kinds that have to be blanched by banking up with earth, but the self-blanching and dwarf kinds can be managed in rows three feet apart. The plants should be about six inches apart in the rows.

Before the plants are dug from the seedbed, they should be thoroughly soaked with water; the plants should have the tops cut off, trimmed, and the roots dipped in water. If

Fig. 103. Celery plants that have been transplanted from the seed box into moist soil rich in rotted manure. Treated in this way, the celery forms a compact root system to which the soil adheres in lumps when the plants are taken up, and on this account the plants are very sure to start well when set out permanently in the field.

the roots are very long they should be shortened so they may be easily handled. The place where they are to be planted should be moist, and every precaution should be taken to prevent the plants' drying out when they are being moved. Special attention should be given to planting on freshly plowed land and to firming the soil around the roots. If the soil is dry it must be watered before it is safe to set out celery plants, and if the weather is very hot and dry the plants must also be shaded from the sun. The ground should be kept clean and mellow between the plants with a horse cultivator throughout the season.

If, while the crop is growing, it is thought the plants require more food, it may be supplied by plowing a shallow furrow away from them on one side and putting in fine well-rotted stable manure, hen manure, or compost and covering it with soil. This treatment supplies the food directly to the roots and is very effective. Nitrate of soda or other nitrogenous fertilizer may also be used to advantage in this way.

Celery and Onions Together.—In some sections celery is grown as a second crop with onions. In this case every fourth or fifth row is left vacant when the onion seed is sown, and this space is set out to late celery plants at the proper time. If the onion seed is sown by the 20th of April, almost any of the well-known commercial sorts like Yellow Danvers or Red Wethersfield will be ripe by the middle of August, when they can be harvested; and then the celery can occupy all the land during the cool weather of autumn, when it makes most rapid growth.

Handling.—As celery grows naturally it spreads on the surface of the ground, like the carrot. The term handling refers to the process by which the leaf stalks of each plant are drawn together and some earth pressed firmly around them by the hands, to hold them in an upright position. After this is done more earth is drawn towards the plants with a hoe, until there is enough to prevent their spreading open. All celery plants should have this upright form before being stored, and it is all the blanching treatment necessary for the self-blanching kinds. The land should be thoroughly cultivated and a furrow turned towards the plants on each side of the row before the handling process is begun, so there may be plenty of loose earth to work with.

Blanching with Earth, or **"Banking."**—If the celery is intended for marketing previous to the first of December, it should be banked up or otherwise blanched in the field. Banking up is done immediately after "handling." It consists in plowing earth against the celery to begin with and then finishing it off with a shovel or wide hoe until the earth

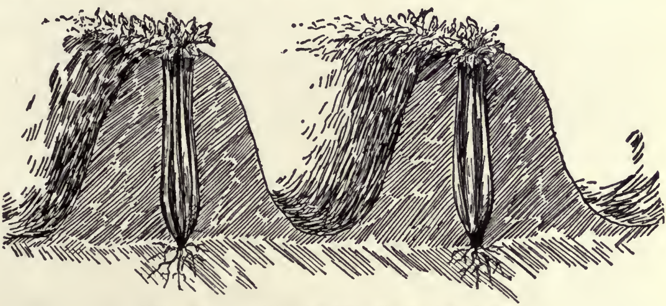

Fig. 104. Celery banked up for blanching.

is banked up to the full height of the celery. This had better be done in several operations as the plants grow and need it.

Blanching with Boards.—Celery that is to be marketed early should be blanched with boards, because if "banked" with earth it is more liable to become diseased. Boards ten inches wide are the best, but narrower boards may be used nearly as well, providing the earth is first drawn towards the plants for them to rest on. The plants are generally handled before the boards are put on, but this is not absolutely necessary, although desirable. A board should be put upon each side of the row quite close to the plants and be held in place with a peg. If for any reason there are vacancies in the row or the plants are not close enough to exclude light from the stalks when the boards are put up, the vacancies may be filled with hay or straw. For late autumn use it is probably best to blanch the plants with earth, as it also protects from frost and is much cheaper than blanching with boards, when the first cost of the boards and the handling of them are considered. In fact, almost all growers use earth to blanch their late celery.

Fig. 105. Celery grown in beds and earthed up to blanch.

Planting in Beds.—Some growers prefer to plant celery in beds four feet wide and to have the plants set ten inches apart each way in the beds; in which case a four-foot path is left between the beds for convenience in cultivation and weeding. In this way a very large amount of celery can be grown on a very small piece of land. By putting boards up on both sides of the paths, the plants will take on the upright form, so that handling will be unnecessary.

For late use the plants may be taken directly from the bed to the cellar without banking, but it will generally be found a good plan late in the fall to pack the spaces between the plants with hay or fill them with earth from the paths, as they will then be protected from frosts. If the celery is to be blanched in the bed, this, of course, would be necessary. To grow plants so close together successfully requires the utmost care in the preparation of the land. It should be covered with fine, rich manure, preferably in the spring; the plants also require to be frequently and heavily watered, since the land will be free of roots.

Digging Celery.—Celery will stand many light frosts, but hard freezing is liable to injure it, and it should never be handled when frozen. It is seldom safe to allow it to remain unprotected in the ground in the North after the middle of October, but by covering the plants with straw or other material they may often be safely left in the field until the middle of November. The plants are generally lifted with a spade or spading fork after a furrow has been plowed away from the row on one side. Most of the soil should be shaken off the roots and the old outside leaves removed before storing. In this section, to keep well, celery should be stored in a cold, moist cellar or frost-proof shed. If it does not whiten quickly enough the plants may be watered and kept warm and thus started into growth, which results in forming the tender white shoots very quickly.

Storing Celery.—For home use a good way to keep celery is to pack the plants closely together, upright, in boxes twelve to eighteen inches wide, with the bottom covered with several inches of moist sand or soil, a little of which should be worked in among the roots. There is no need of having sand between the plants. These boxes, when packed, should be kept in a cold, damp cellar. In storing for market use, where there is plenty of storage room, the plants are sometimes "heeled in" in sand on the floor; the cheapest practical way, however, is to pack them between boards about nine inches apart. To do this, place the first board on one side of the cellar or shed nine inches from the wall, with its upper edge at a height from the floor a little less than the length of the celery. The boards may be supported by stakes and should not rest on the ground. In this narrow division the celery should be packed upright as described for packing in boxes. As soon as the first tier is filled, erect another board division at nine inches from the first, and so continue until the whole surface is covered. No soil or sand is packed among the stalks of celery, but three or four inches of either is placed on the floor, into which the roots are bedded.

The temperature of the celery should be kept very low, and even a little frost in the cellar will not hurt it. If dry, it must be watered, but water must not be put upon the leaves, as it may bring on rot. If celery is wanted for immediate use, it may be stored in barrels or troughs containing an inch or two of water. This is also a very good way of hastening the blanching process.

The green stalks of celery do not become white, for the process is not that of blanching. The blanching of celery is simply the result of the plant's growing in the dark. Blanched celery will keep but a short time and should be used as soon as white. Celery for use in the latter part of winter should be quite green in color when put into winter storage; for early winter use it should be partly blanched when stored. For winter use celery should be left out as late as is safe in the fall, so that the cellar or pit where it is to be stored may be thoroughly cooled off before it is put in.

The time required for blanching celery in the field will depend upon whether it is growing rapidly or not. During the first part of September, when it is making a rapid growth, it will probably be fit to use in three weeks from the time it is banked up; while later on, when the weather is cool and the celery is growing slowly, four weeks will be found necessary. The same conditions affect the blanching process after storing. In an ordinary frost-proof cellar, it may easily be blanched in three weeks by watering it and then raising the temperature to fifty degrees.

Celery seed is raised by wintering the roots and planting them out in the spring, in much the same way that seed of the carrot and other biennial plants is grown. Much of our seed comes from France, especially the self-blanching varieties. The variety Boston Market is grown near Boston, and some of the other kinds come from California. Fresh seed is best to plant, but it may be kept for several years in glass jars carefully sealed. Good seed is essential for success in celery growing.

Diseases.—There are two diseases, rust and leaf blight, that sometimes seriously injure celery, but they are not commonly very troublesome. As a rule, celery growers do not attempt to fight them, but select the healthiest varieties and trust to good cultivation to enable the plants to resist them. The diseases referred to are described as follows:—

Leaf Blight (*Septoria petroselini* var. *apii.*).—All parts of the celery plant except the roots are liable to the attacks of this fungous disease. Watery spots appear on the stems and leaves, which soon show small black dots. This disease may be spread by the seeds, which are likely to become infected.

Treatment.—The first precaution is to plant clean seed. That which is spotted or speckled with the black spots of disease should be avoided. In addition it would be a good plan to spray the young plants with Bordeaux mixture on the first appearance of the disease.

Celery Blight, Rust or **Sun-Scald**—(*Cercospora apli.* [Fries.]).—The first indication of this disease is the appearance of yellowish spots on the leaves. These finally run together and turn the entire leaves yellow and then brown.

Fig. 106. White Plume celery.

Treatment. — Secure as healthful conditions as possible. Where the plants are somewhat shaded, they are less liable to the disease than if in the full sunlight. This disease is especially bad in very dry locations. It is reported that the Bordeaux mixture and other standard fungicides will entirely prevent it.

Varieties of Celery. — The dwarf kinds are the best to grow; the red varieties are of excellent quality but do not take well in the markets. For early marketing the White Plume is highly esteemed and probably the most profitable variety for general marketing. It is, however, somewhat subject to blight. Its stalks and leaves are white without going through the blanching process, but are not of as good flavor as when blanched. Golden Self Blanching is another similar variety, that is considered by some growers superior to White Plume. Winter Queen is one of the most extensively grown varieties for winter storage. Other good late varieties are Giant Pascal and Boston Market.

Celeriac, or **Turnip-Rooted Celery,** is a form of celery cultivated for its roots, which are eaten either cooked or raw. The stalks are generally hollow and quite worthless. The plants are raised by the same method as that for celery but may be planted in rows not over twelve inches apart. The roots are generally kept by storing them in moist sand the same as carrots.

Fig. 107. Turnip-rooted celery, or celeriac.

The use of celery as a food and relish has increased wonderfully during the last ten years. It was formerly regarded as a luxury, while it is now recognized as a food. Thousands of cars are shipped annually from the celery districts of Michigan, Ohio, Florida, Texas, and California. Growers in the North find it a very valuable crop, realizing as high as one thousand dollars per acre from it.

Marketing.—Celery is marketed when well blanched. In preparing it for market most of the roots are trimmed off and the green and decaying leaves are removed. About a dozen roots are generally tied together for a bunch, although the size of the bunch varies in different markets. Celery can be easily shipped long distances when trimmed and packed in tight boxes. Much of that which is supplied to the markets of this section comes from Kalamazoo, Michigan, where it is raised on drained swamp land.

THE MORNING GLORY FAMILY (Order Convolvulaceae)

The Morning Glory Family includes mostly twining, trailing, or rarely erect plants. (Some tropical species are shrubs or trees; ours are herbs.) Commonly with some milky juice, alternate leaves, no stipules, regular gamopetalous flowers; fruit a 2-to 4- valved capsule. The sweet potato is the only vegetable of this group which is here mentioned. This family also includes the morning glory, bindweed, and man of the earth.

SWEET POTATO (*Ipomea batatas*)

Fig. 108. A hill of sweet potatoes and a portion of the vine.

Description. — Native of South America. Perennial, but cultivated as an annual. It is a near relative of the morning glory and scarcely resembles the common potato in any particular. It probably cannot be profitably raised in the extreme Northern states, but may be grown in a small way in warm, sandy soil as far north as Minnesota, and will produce even there very large potatoes. The plant never flowers at the North and is never cultivated from seed. It is one of the most important vegetables of the South.

It is estimated that the United States produces about 50,000,000 bushels per year.

Culture.—The sweet potato is raised from sprouts, which are produced abundantly if the potatoes are planted in a hotbed in the early spring. The sprouts are carefully pulled from the potatoes and are planted out after the soil has become warm. They should be set two feet apart in rows four feet apart. They need considerable care until started, after which they require good cultivation only, and are easily grown. The vines spread on the ground and have a tendency to root at the joints, which should be discouraged by moving them at every hoeing. They are very susceptible to cold weather and should be pulled as soon as the tops are frosted. There are many cultivated varieties in the South. For the Northern states, Early Carolina is perhaps the best.

THE POTATO FAMILY (Order Solanaceae)

The Potato Family is made up of mostly herbaceous plants with rank-scented herbage (this and the fruit more commonly narcotic-poisonous), colorless juice, alternate leaves, regular flowers with the parts usually in fives. There are many poisonous plants in this group, which fact led to the tomato's being regarded with much suspicion for many years, and the tops of potatoes and even tubers that have become green by exposure to sunlight contain a poisonous principle. Besides the potato, tomato, eggplant, pepper, and strawberry tomato, whose cultural directions are here given, tobacco, petunia, Nightshade, Datura, Salpiglossis, Jerusalem cherry, and Nierembergia of the gardens, belong to this family.

POTATO (*Solanum tuberosum*)

Description.—Native of the high mountain regions of South America. Grown as an annual, but truly a perennial through its tubers. Its stems are more or less four-angled. The flowers vary in color from white to purplish. Many kinds do not flower, and most varieties seldom, if ever, produce fruit. The fruit is a roundish or slightly oval berry, of a green color or tinged with violet brown, and averaging about an inch in diameter. The pulp is green and very acrid. The seeds are white, kidney-shaped, and flat. The seed is never sown except in producing new varieties. Seedlings vary greatly and often do not obtain full size until three years old. The tubers are commonly referred to as "seed," but they should be regarded as cuttings or sets; they are only swollen underground branches filled with starchy matter. They vary much in size and shape and in color of skin, from white to almost black, including yellow, red, and blue. There are a thousand or more named varieties, but many of them are scarcely distinguishable from other named kinds.

Fig. 109. A hill of white potatoes, showing top, tubers, and roots.

Origin of the Modern Potato.—Sixty years ago potato rot ran over western Europe and the United States to such an extent as to bring starvation in regions where potatoes were the principal article of diet. No one knows where the potato came from that was cultivated previous to that time. Rev. Chauncey Goodrich, of Utica, New York, urged before agricultural societies and the agricultural committees of the New York legislature that potato rot resulted from lowered vitality of the potato plant, due to its being grown under high cultivation and in climates and soils not wholly congenial to a sub-tropical plant, native to a small section only of the earth's surface; and he claimed that the way to restore its vigor would be to get varieties from the part of South America that was the home of the potato. His theories were laughed at by scientific men, and the legislative committee told him he knew more about theology than about plant diseases.

Being thus repulsed, he attempted on his own account what he felt should be undertaken by the state. Mr. Goodrich commenced his experiments about 1848, and at various times for many years imported potatoes from South America, and from these and their progeny he raised many seedlings. Among eight kinds received at one importation (probably from Chili) was a variety that he called the Rough Purple Chili. It ripened late in the season and was generally hollow, but it had flesh of fine texture and was free from rot. From seed saved from this he raised the Garnet Chili, which was a popular variety for many years in New York state. The Garnet Chili was parent of the Early Rose and of Brazee's Prolific and other Brazee seedlings and, indeed, of nearly all of the desirable varieties of Europe and America which have been prized for half a century. Although from some of his other importations he also raised a few very good sorts, yet the progeny of the Rough Purple Chili gave him the most valuable kinds.

Among Goodrich's other seedlings were Gleason, Calico, Harrison, and Early Goodrich. The latter was the parent of the Chicago Market.

Mr. Goodrich is said to have raised about sixteen thousand seedling potatoes from 1848 to 1864. Out of this large number he found only about one in a thousand that he thought enough better than the old sorts to make it appear probable that they would be desirable for cultivation. The work that he did in this line has been of great value to Europe and America.

Soil and Manure.—Potatoes can be grown on soil of almost any composition provided it is well drained, but a light, sandy soil is best. It produces potatoes of better table quality than those grown on rather low, wet, or heavy clayey soils. New soil is most desirable. If old soil must be used, it is best to precede the potatoes with a crop of clover. Clover adds nitrogenous plant food and humus to the soil, and makes it more porous. If potatoes are planted on sod land, the "seed" should always be under the sod, otherwise the crop is liable to suffer from drought. Fresh manure should, preferably, be applied the year before the crop is to be grown. Where clover precedes potatoes, a good time to apply the manure is after the first crop has been cut, or during the previous winter or spring. This gives the manure time for decomposition preparatory to its incorporation with the soil. Soil on which a scabby crop has been produced should not be planted to potatoes again for a number of years.

Potato Rotations.—The advantages of preceding potatoes with clover have already been referred to. Rotations that include this crop and have been found desirable are as follows:—

(1) Three year: small grain, clover, potatoes.

(2) Four year: corn, small grain, clover, potatoes.

With the four-year rotation a good crop of corn is produced. A two-year rotation consisting of clover and potatoes can be followed, where the sod is wanted in one year, by sowing the clover alone on a well prepared seed bed early in the spring.

Size of Sets (commonly called "seed").—The tubers for planting should be sound and not sprouted. Sprouting weakens their vitality. The potato is a thickened underground stem. The eyes contain several buds, which, like the buds on a willow cutting, should be dormant when set out. Every piece of tuber cut for planting should possess at least one strong eye and be large enough to nourish the new growth until well established. The size of the piece is more important than the number of eyes. If the variety has few eyes, then pieces of proper size will be obtained by cutting to one eye. With the average variety pieces of good size will have two and frequently three eyes. Perhaps fifteen bushels per acre will generally give the most profitable returns with the best cultivation and soil. The usual amount used is from eight to eleven bushels per acre.

Cutting the seed by hand is the best plan where potatoes are grown on a small scale. Some machine cutters leave a large number of pieces without eyes, especially with those varieties having few eyes. Much of this difficulty can be avoided by using only hand-feed cutters.

Selection of Seed Potatoes.—Varieties of potatoes seldom retain their pristine vigor and productiveness many years, except in very favorable locations. On some land, even with the best of care, they are apt to "run out." As a rule, it is a good plan to get seed stock occasionally from locations favorable to the best development of the potato, or at least to change for seed potatoes grown in a different kind of soil. The continued use of small tubers for sets contributes very much to the "running out" of varieties. Small tubers should never be used except as a last resort in a case of need. Many hills produce only small tubers, or numerous small ones and few large ones. By selecting only small tubers, all of these undesirable hills are perpetuated and not a single hill that produced only large tubers is represented. Hence, in selecting from bins it is best to take only medium and moderately large ones.

The best way to select is by individual hills in the fall during digging time, when the product of each hill can be seen. Select those hills producing the largest number of moderately large, smooth, well-shaped tubers. With the rows three feet apart, and the hills eighteen inches apart in the row, if a strain can be selected that will produce only six moderately well-sized tubers per hill, weighing a total of two pounds, it will produce a yield of about 320 bushels per acre. If the crop is dug with a machine, hill selection may be carried on by going over the patch beforehand and digging up the most vigorous-looking hills and saving the best ones, or by leaving a strip through the best part of the field to be dug by hand. If only a few bushels can be selected, plant them in a separate strip. From this the best hills can be selected for the next year's strip and the bulk used to plant the main crop.

Early Planting.—For early use potatoes should be planted as soon as the ground is nicely settled. Light, sandy loam is best for this purpose. The tops are quite sensitive to frost, but, as they start slowly, they seldom get up until all danger from frost is past. If there is danger from frost when the tops are pushing out of the ground, the plants are easily protected by covering lightly with loose earth from between the rows, through which covering they soon push again. If frozen off when several inches high, the crop is generally seriously lessened, even though new sprouts take the place of those injured.

For early crops, the ground may be plowed several times in the spring to expose it to the air and to warm it before planting. The sets for the early crop should not be covered quite so deep as for the main crop, but in other particulars the crop should be treated the same way, and the quickest-maturing kinds only should be planted. If the tubers for early sets are spread out in a light, warm room for three or four weeks before planting, healthy green sprouts will start from the eyes, and if, in cutting, these sprouts are carefully handled so as not to break them off, the crop will be much earlier than if the sets were not thus started. They may also be started in a hotbed before or after being cut and afterwards transplanted to the open ground; but these methods are seldom practiced except in a very small way, although in some sections they might perhaps be made profitable.

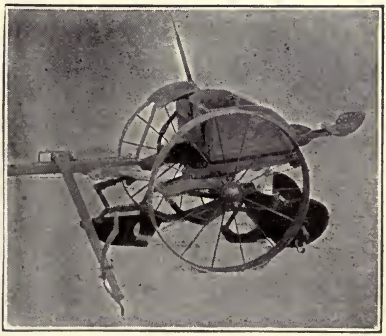

Fig. 110. One type of self-drop potato planter.

Main Crop.—For the main crop of potatoes, it is desirable to have the seed in the ground pretty early. It is customary in the North to plant from the middle of May to the first of June. When planted later they are liable to suffer seriously from drought, and earlier planting is more desirable. The results of many experiments show that the sets should be planted about four inches deep, at sixteen inch intervals, in rows three feet apart. This work may be done by furrowing out with the plow or horse hoe, planting by hand, and covering the sets with the plow; though when planted on a large scale the work is generally done by a potato planter. There are several excellent potato planters on the market.

Some good growers prefer to plant the sets in check rows three feet apart each way when the land is weedy, but so much space between the plants is not generally profitable, since under ordinary circumstances thorough harrowing when the crop is young will destroy all weeds. If the sets are planted four inches deep, very little hilling up is required; if planted much deeper the digging is quite difficult; if planted nearer the surface, the tubers are liable to push out of the ground and require to be hilled up, which is not desirable.

The land should be harrowed or thoroughly cultivated with a Breed's weeder as soon as the smallest weeds can be seen or a crust forms on the land after planting. It is entirely practicable to harrow potatoes at least three times, the first time just before the plants show, the second when they are just above ground, and the third when the plants are three or four inches high. Little if any harm will be done the plants by this work, providing a slanting tooth harrow is used. Such treatment will do more to remove weeds than a good hand hoeing, and the expense of the operation is almost nothing. If the work is properly done, there is seldom any need of hand work with this crop.

Subsequent cultivation should consist in keeping the soil loose between the rows, and a little earth should be thrown against the plants. For this purpose a good horse-hoe will do excellent work, but a still better implement is a two-horse cultivator that works both sides of the row at one operation. It is not a good plan to hill up potatoes, and it should not be done unless they are pushing out of the ground, when they will turn green if not covered up. Cultivation should be thorough when the plants are young, but is not desirable after the crops have made most of their growth.

Digging Potatoes.—Early potatoes are generally dug as soon as they are big enough for cooking if there is a good market for them; for winter use it is very desirable to have the tubers well ripened; if not ripe the skin will peel off when handled, and they do not look well. When potatoes are high in price it may pay to dig them by hand, for which purpose tined garden forks are desirable; the best potato diggers, however, do as good work as can be done by hand, and are generally used by those who raise this crop on a large scale. When potatoes are cheap, they should be dug with a potato digger or plowed out; though when plowed out some tubers will get covered up, most of these may be brought to the surface by the use of a straight tooth harrow. If the tubers are keeping well in the ground, it is a good plan to delay the digging until the cool weather of autumn, when they may be carried directly from the field to the cellar. If they are rotting in the ground or are "scabby," they should be dug at once, and if the cellar is cool they may be put at once into it, otherwise it is a good plan to pit them in the field until cool weather comes.

Pitting in mild weather is done by putting the tubers into heaps and covering them with straw or hay and a few inches of loam. The straw should be allowed to stick out along the top of the heap for ventilation, so as to allow the moisture to pass off. In the colder weather of late autumn, the covering, of course, should be heavier, and when potatoes have ceased to sweat there is no need of ventilation. In milder sections, potatoes are stored through the winter in such pits, but it is impracticable farther North. Even in Minnesota, however, potatoes may be safely kept over winter in trenches or pits made below the ground, although a good cellar is a more desirable place. For this purpose the pit should not be large; a good size is four feet wide and deep and not more than

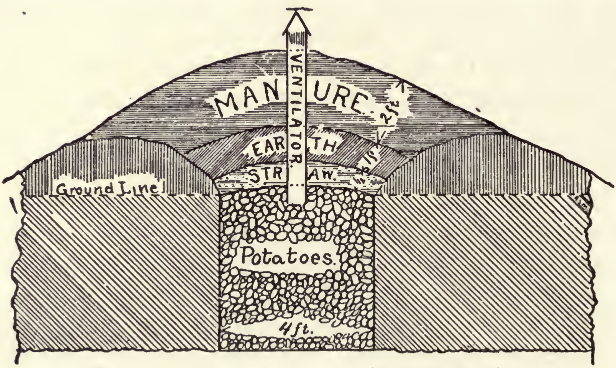

Fig. 111. Cross section of a winter potato pit.

six feet long. It should be filled heaping full with potatoes and covered with six inches of straw and eighteen of soil. Ventilation is given until cold weather sets in and the potatoes are cooled off. The whole pit should then be covered with enough litter or manure (generally about two feet) to keep out the frost. Such pits can only be opened in mild weather. If this work is well done, the potatoes will be in fine condition in the spring; but beginners are very apt to fail of success in this method of storing, and they should attempt it only on a small scale. It is better to make several pits close together rather than one large one, since in a large one the potatoes are more likely to sweat. The sunlight should not be allowed to shine on them for any length of time, since it causes them to turn green and develops a poisonous substance in them. If kept in a cellar the bins are improved by having slatted floors and sides, so that there may be some circulation of air through them to prevent heating at the bottom. The bins should not be large nor more than five feet deep.

Fig. 112. A potato storage house.

There is a great difference in the keeping qualities of varieties; as a rule the early kinds are hard to keep from sprouting in the latter part of the winter, and the late kinds keep the best.

Starch.—When potatoes are low in price, they can often be profitably worked into starch, but for this purpose starch factories must be near by. Such factories are not expensive and should be more common in potato sections.

The demand for potatoes seems destined to increase very much. There is a growing demand each year from the Eastern and Southern states for Northwestern-grown potatoes. Under cultivation, in Minnesota, they seldom yield more than 150 bushels per acre of marketable tubers, and the average even in favorable years is probably not over 120 bushels per acre. There are, however, recorded yields here of 800 bushels per acre, and they often yield over 400 bushels.

Varieties.—There is a very great difference in varieties, but many kinds closely resemble one another. There is quite a difference in the adaptability of varieties to soils.

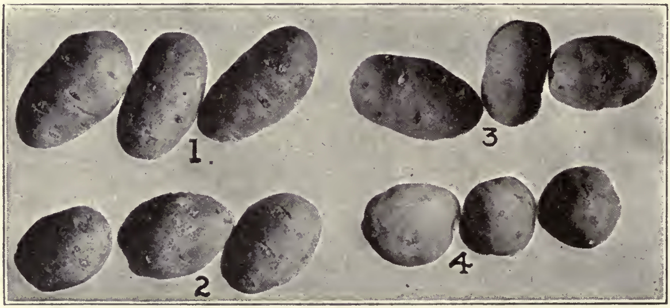

Fig. 113. Four good varieties of early potatoes; *1*, Acme; *2*, Early Ohio; *3*, Early Harvest; *4*, Irish Cobbler. (3 and 4 are on a smaller scale.)

The large coarser kinds are good for starch but not desirable for table use. Most markets prefer a white or pink potato, moderately long, oval in form, and smooth; but the fashions change and vary considerably. Some of the varieties at present regarded with much favor are:—

Early Ohio.—The most popular early kind and a good sort for the general crop; productive and very early.

Rural New Yorker No. 2.—Form roundish to roundish-oblong, flat. Eyes shallow. The variety is very productive. The quality is a little inferior, and the tubers are inclined to be hollow. They are influenced by the soil in which they are grown.

Sir Walter Raleigh.—Quite similar to the above. Perhaps a slightly heavier yielder.

Carman No. 3.—Of the same general type as the two immediately preceding. The quality is said to be better and the yield perhaps a little less.

Fig. 114. Four good varieties of late potatoes; *1*, Sir Walter Raleigh; *2*, Rural New Yorker; *3*, Carman No. 1; *4*, Carman No. 3.

White Star.—This variety is largely supplying the demand for a long white potato, in place of the Burbank, which is running out. The eyes are not as shallow as the Burbank, and the thickness not so well carried out to the ends.

Russet.—Tubers long, skin russet, excellent for baking, moderate yielder.

Other varieties of merit are: Acme, Irish Cobbler, Early Michigan (in good soil) and Early Harvest for early; American Wonder, Carman No. 1, and White Elephant for late.

Note on Propagation.—New varieties of potatoes are generally high in price, and it is desirable to increase them rapidly. This may be done as follows: Place the tubers in rich soil in boxes or pots, without cutting them, in a warm, light room, hotbed, or greenhouse. As soon as the sprouts are nicely furnished with roots, break them off at the surface of the potato below the roots and plant separately in pots. New sprouts will start from the eyes again, and the process may be repeated until the tuber is exhausted. By another way the tubers are cut up and planted in good, rich loam. As soon as the shoots are

Fig. 115. Some degenerate types of potatoes.

six inches or more high, about three inches are cut off the top of each. These pieces are put in moist sand, watered frequently, and allowed all the sunlight they will stand without wilting, and treated the same as it is common to treat cuttings of house plants. In two or three weeks they will be well rooted and may be potted in rich soil. These shoots may again be cut when nicely started, and so on. The plants thus grown are planted out when the weather is settled in the spring. For best success with these methods of propagation, the work should begin in the late winter or very early spring.

Insects.—There are but few insects that do serious injury to the potato in this section, and the most important of these is the Colorado potato beetle or "potato-bug," but it may also be injured by blister beetles, wire worms, and white grubs. (For remedies for these pests, see chapter on insects.)

Diseases.—There are several diseases that sometimes injure the potato. The most common of these are known as the scab and the blight. Scab is a term used to refer to the rough patches with which potatoes are frequently covered. Potatoes so infected are lessened in yield, and on account of being unsightly and rough do not sell readily. The term blight refers to a disease that kills the tops.

Scab of potatoes is caused by a fungous plant working in the surface of the potato. The germs of it are very

Fig. 116. Potato scab. Both groups were grown from the same lot of scabby seed,—those on the left from treated seed; those on the right, untreated.

abundant and live for many years in the soil and also over winter on the potatoes. If these germs are fed to stock they undoubtedly grow in the manure, and the use of such manure may often be the cause of infection. Also they may be spread in the soil by natural drainage and the land receiving the drainage from infected fields may become infected with the disease without ever having had potatoes on them. Scabby seed potatoes when planted on new or old potato land will generally produce a scabby crop, but the amount of the disease will generally be much more on the old land than on the new.

Perfectly clean seed potatoes planted in soil free from the scab fungus will always and in any season produce a crop of smooth, clean potatoes, no matter what may be the character of the soil; but apparently clean seed potatoes may have the germs of the scab fungus on their surface. This is often the case where they have been sorted out from a lot that is somewhat infected with scab. In this latter case the tubers should, at least, be thoroughly washed in running water to remove any germs that may be present or, what is better yet, be treated with corrosive sublimate (mercuric bichloride) as recommended below.

Land infected by the germs of potato scab will produce a more or less scabby crop, no matter how clean and smooth the seed used.

Scabby potatoes should be dug as soon as mature, since the scab fungus continues to grow on the potatoes as long as they are in the ground.

Scabby potatoes may be safely used for seed provided they are first treated in such a way as to destroy the germs of the scab that adhere to them. There are many methods of doing this but the most practical now used are as follows:

Corrosive Sublimate Treatment.—Procure from a druggist two ounces of powdered corrosive sublimate (mercuric bichloride); put this into two gallons of hot water in a wooden or an earthenware vessel and allow it to stand until dissolved. Place thirteen gallons of water in a clean barrel, pour in the solution of corrosive sublimate and allow it to stand two or three hours, with frequent stirrings in order to have the solution uniform. Select potatoes nearly free from scab as can be obtained; put the seed potatoes into bags, either before or after cutting them; then dip them into the corrosive sublimate solution and allow them to stay in for an hour and a half. If seed potatoes are treated in this way and then planted on land free from scab, the resultant crop will seldom be seriously injured by scab. The expense of this treatment including labor, should not exceed one dollar per acre, as the material may be used repeatedly. But the treated potatoes should never be fed to animals, as corrosive sublimate is a deadly poison.

Formalin Treatment.—This material should be mixed with water at the rate of eight ounces (one half pint) of commercial formalin to fifteen gallons of water. The potatoes should be soaked two hours in it. If this method is used the seed should be planted within two or three days after treatment. This material gives equally as good results as corrosive sublimate. It is slightly more expensive, but the expense is light in any case. It has, however, great advantages over the latter in that it is not poisonous and, being a liquid, is easily diluted for use and may be used in almost any kind of receptacle. This material does not in any way injure the tubers or make them dangerously poisonous. One pound of formalin, costing not more than fifty cents, will make thirty gallons of the disinfecting solution and is enough to treat fifty bushels of potatoes. If the solution stands a long time it will probably lose strength.

Exposing to Light.—If the tubers are exposed to the full sunlight for several weeks before planting, the scab germs will be largely destroyed. It would be a good plan to turn such potatoes occasionally in order to expose them fully to the light.

Blight of potatoes is a disease which attacks the leaves and stems of potatoes, and sometimes even the tubers are affected. It is most prevalent during moist, warm weather, when sometimes the fungus may be seen as a delicate white mildew on the stems and leaves of the potato vines. In seasons favorable to it, the tops of an entire field may be killed in a few days from the time the disease was first noticed; at other times the tops die so gradually that it is mistaken for natural dying of the vines. Rotting of the tubers often follows the dying of the tops. It has been quite clearly shown that this disease may be kept in check or the trouble entirely prevented by spraying the tops with Bordeaux mixture occasionally. It is, however, somewhat doubtful about the benefits being sufficiently certain in the Northwest to justify the expense; but should this disease become more abundant spraying may prove a paying operation. The cost of treating one acre with the Bordeaux mixture is about $5. There is little use of applying this mixture after the damage from the disease is apparent, for it is a preventive and must be used before the disease is seen.

Bordeaux mixture is made as follows: Dissolve five pounds of blue vitriol (sulphate of copper) in ten gallons of water in a wooden or earthenware vessel. As this substance dissolves very slowly in cold water and solutions of it are very heavy, it is well to suspend it near the top of the water. (It dissolves more quickly in hot water.) In another vessel, slake five pounds of good, fresh quicklime in ten gallons of water. When the mixture is wanted, pour the blue vitriol and lime slowly at the same time into a barrel containing thirty gallons of water, stirring all the time. When thoroughly stirred the mixture should be of a clear sky blue color. After being mixed for a day or two the mixture loses much of its strength, so it is well to use only that which has been mixed for a short time. There are many formulas used, which vary as to the amount of lime and water, but the above gives good satisfaction when used properly.

Internal brown rot is the name given to a disease which has recently appeared in a few potato-growing sections of this country. It is first noticed by the darkening more or less of the starchy portion of the tubers,

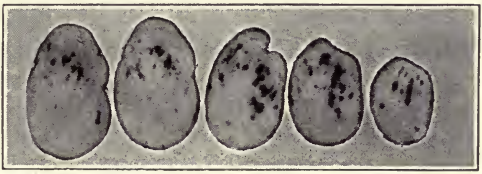

Fig. 117. Internal brown rot of the potato. (Maine Bul. 149.)

without any manifestation of its presence on the outside; later on the potato rots. The life history of this disease is not known, nor are any remedies known for it. Ordinary prudence, however, would indicate that seed potatoes in the least affected with this trouble should not be planted.

EGGPLANT (*Solanum melongena*)

Description.—Native of South America. An annual. Stem erect and branching; flowers solitary and violet in color; seeds flat and of medium size. The eggplant is but little used in this section, but can be grown to perfection in our hot, dry summers. The seed must be sown even earlier than tomato seeds, in the greenhouse or hotbed; but when only a few plants are wanted it will be found best to buy the plants, as they require delicate handling. The plants are set in rows three by two feet apart, after the ground is well warmed up, which is seldom before the 10th of June.

The fruit attains marketable size by the last of August. The plants are very liable to the attacks of the potato beetle.

The best variety is the New York Purple, but the variety known as the Long Purple is somewhat earlier. The New York Improved Black Beauty, Black Pekin, Early Long Purple, and Ivory, the white variety, are the principal kinds grown for the market.

TOMATO (*Lycopersicum esculentum*)

Description.—Native of South America. A perennial, but generally treated as an annual. The tomato is a branching plant, generally with flexible stems that require support to grow erect. Its flowers are yellowish and grow in loose clusters on the stem; opposite or nearly opposite leaves, not axillary; fruit a true berry, red, pink, or yellow in color; seed kidney-shaped, flat, with a roughened surface. In many parts of the country the tomato can be successfully grown as a market crop, and there is no place where it can not be grown in sufficient quantities for home use. The cultivation of this vegetable for canning purposes is already occupying the attention of farmers in a few localities in this section, and it is an industry that is destined to greatly increase in the future. It is one of the easiest and surest crops to grow, providing one has good plants to start with.

Growing the Plants.—It is especially important to sow the seed before the first of April, and the middle of March is thought about the right time by most growers. The seed grows easily but needs considerable heat and rich soil to do its best. The plants should be transplanted after they have their second leaves and again when they get crowded, so that they may become stocky and strong. The seed may be started in greenhouses or hotbeds; it is also easily grown in window boxes. If too close together, they grow weak and poor. It is very important that the plants should be well hardened off before they are set in the open ground.

The land preferred for tomatoes is a rich, retentive sandy loam, but they will do fairly well on almost any well-drained soil, and even if on rather poor soil will do better than most crops. A southern slope is preferable, but they will ripen almost anywhere if properly managed. The tomato pre-eminently needs a warm place, and if rich manure is plowed into the soil it is beneficial, since by its fermentation it raises the temperature of the land.

Transplanting and After-cultivation.—The plants should be moved to the open ground as soon as all danger of severe frost is past, which will generally be about the 20th of May in southern Minnesota, and not until the 1st of June in more northern sections. They should be set about five feet apart each way and about six inches deep. If the stems of the plants when planted out are very long, they should be partly buried under ground. They need thorough cultivation, which can best be given by a horse cultivator on a large scale.

Pruning and Training.—Tomato plants under field cultivation are generally allowed to run over the ground in any direction and are not trained; but even under this method of management it is a good plan to cut off a foot or more of the ends of all growing shoots about the middle of August if they are growing rapidly, so that all the strength of the plant may go to ripen the fruit that is well formed and still green. Some growers advise pruning off all but one main stem and two or three laterals and training to a stake, and then pinching off all flower clusters after a few have set fruit. The result of this practice is that earlier and larger fruit, but not so much of it, is borne on the plant. It is a good plan in a small garden to cover the soil under the vines, after they set fruit, with a little hay, so that the fruit may be kept from getting dirty in case they are not trained. This covering should not be heavy enough to keep the ground from getting plenty of sunlight. Plants may also be supported on barrel hoops or other supports, to keep the fruit off the ground.

Tomatoes in Very Severe Locations.—When there is danger of frost in August, a sufficient supply of tomatoes for family use may be grown on the south side of a house, wall, or other protection, especially if the plants are covered on cold nights. Where this seems to be impracticable, a most excellent way is to grow a few plants in barrels placed in warm corners about the buildings. To do this, at planting time select a barrel as large as a coal oil barrel, bore three or four holes in the bottom, sink the barrel about one-third its depth in the ground and pack the earth around it. Fill it about half full of fresh horse manure well tramped down, and pour a bucketful of hot water on this manure. Then put on eight inches of good soil and then a mixture of well-rotted manure and rich black loam in about equal quantities, up within about twelve inches of the top of the barrel; then heap up manure around the outside. Set three plants in this and trim to two shoots each. Train one of these shoots from each plant to stakes or a near-by building, but allow the other three shoots to grow naturally over the sides of the barrel. Be careful to give plenty of water daily—a gallon each day will be none too much. Three or four old barrels treated in this way and placed in a sunny exposure will produce all the tomatoes needed by a family of four or five persons.

Prolonging the Tomato Season.—In autumn the tomato season may be prolonged by pulling the plants with the unripened fruit on them and hanging them in a shed, where they will continue to ripen fruit for some time. The larger tomatoes will ripen very well if picked off and kept in a shady place.

Saving Tomato Seed.—Tomato seed should be saved from the best tomatoes from vines producing the largest amount of good fruit. The tomatoes should be thrown into a barrel as fast as they ripen and be allowed to ferment until the seed separates readily from the pulp, when they should be put into water and thoroughly stirred. The skin and pulp being lighter, the seed is readily separated from it. The seed should be dried at once by spreading it out thinly in a dry place.

Fig. 118. Cross section of tomato, showing the small seed cavities and thick walls of good shipping sorts. (U. S. Farmers' Bul. 220.)

Varieties.—There are many good varieties of tomatoes. June Pink is good for early, but lacks the color desired on the market. Acme and Dwarf Champion are good second-early pink-skinned varieties. Selected strains of Spark's Earliana are the best for early red tomatoes. For late red-skinned varieties, Beauty seems to be quite a favorite, and Stone, an old standard, is also good. It does not usually pay to grow the earliest varieties for general crop, since they are inferior. In many unfavorable localities, however, it may be best to grow them, as they do very well for home use.

Marketing.—Tomatoes are sold in various sorts of packages, holding from a few pounds to a bushel. Canning factories pay from $7 to $10 per ton. Yields will run from 500 to 1,000 bushels per acre, depending on the management of the crop.

Fig. 119. Tomato rot.

Insects.—The tomato is subject to few insect pests. It is sometimes attacked by the potato beetle. The remedy is Paris green and water, as recommended for the same insect when it attacks the potato.

Tomato Rot.—There are several diseases that attack the tomato when grown in greenhouses, but only that known as the "rot" is often seriously injurious to plants grown in the open field. This is a fungous disease, the germs of which lodge in the ends of the young fruits, probably often just as the flowers fall off. By their growth they rot the ends of the tomatoes and often cause much loss.

Remedies.—The disease lives over winter in the ground where the rotten tomatoes have fallen. The diseased fruit should therefore be gathered and burned or buried a foot or more deep, where they will not be disturbed in the spring. Some varieties are much more liable to rot than others. The Dwarf Champion is perhaps less affected than many other kinds. Experiments with spraying the young fruit with Bordeaux mixture or a solution of sulphide of potassium at the rate of one-half ounce per gallon, are said to have given good results in some cases, but it is generally considered impracticable to do this, on account of the labor necessary to do the work well. They are less liable to rot when growing on new land than on land that has been used for several years in tomatoes.

GROUND CHERRY, OR STRAWBERRY TOMATO (Physalis sp.)

Fig. 120. Ground cherry, or strawberry tomato.

Description. — Native of North and South America. A perennial. There are several species of Physalis that produce edible fruit. Among those indigenous to northern United States is one quite common in old timber land in northern Minnesota and elsewhere. The fruit resembles a tomato but is about the size of a cherry and is enclosed in a husk formed of the calyx. The seed is dark colored, flat, and round. The fruit is used for preserves and sauces.

Culture. — It is a plant of the earliest culture and when once sown generally covers the ground in following years from self-sown seed. The seed should be planted about the first of May. The plants spread about thirty inches.

PEPPERS (*Capsicum annuum*)

Description.—Native of South America. A perennial, but in cultivation is grown as an annual. There are many varieties, differing chiefly in the shape of their fruit. All of them have erect, branching stems, which become almost woody. The leaves are spear-shaped; flowers white, star-shaped, solitary in the axils of the leaves; fruit generally hollow with a somewhat fleshy skin, at first dark green, but when ripe turning yellow, red, or dark violet.

Fig. 121. Varieties of peppers; *1*, Bird's Eye; *2*, Tomato Shaped; *3*, New Orleans; *4*, Golden Bell; *5*, Very Small Cayenne; *6*, Sweet Spanish; *7*, Cluster; *8*, Ruby King; *9*, Celestial. (After Landreth.)

The seeds are flat, and, like the flesh of the pods, have a very acrid, burning taste, for which the plant is cultivated and used in giving flavor to pickles, etc. Their germinating power lasts about four years after being separated, but if left in the pods they will keep much longer without injury.

Culture.—Peppers need practically the same cultivation as the tomato or eggplant, except that they may be planted two feet apart, in rows three feet apart.

Varieties vary much in the shape of the pods and the acridity of their juice. The kinds most commonly grown are as follows:—

Ruby King.—Fruit very large, bright red, smooth, mild flavored and prolific. The best for general use.

Long Red Cayenne.—Fruit long and slender. Very pungent.

Other varieties are Bull Nose, Chinese Giant, and Neapolitan.

THE MARTYNIA FAMILY (Order Martyniaceae)

MARTYNIA (*Martynia probosidea*)

Description.—Native of southwestern United States. An annual. A coarse-growing, spreading plant, having a peculiar-shaped fruit that is used for pickles. The flowers are large, irregular, and rather pretty. The fruit is tender when young, but is nearly as hard as horn when ripe. The seeds are black, with a rough surface.

Fig. 122. Martynia.

Culture.— This is a plant of the easiest culture. The seed should be sown as soon as the soil settles in the spring, in hills about three feet apart each way. Where seeds are allowed to ripen, plants usually appear the following spring. There is only one kind.

THE GOURD FAMILY (Order Cucurbitaceae)

The Gourd Family is made up mostly of tendril-bearing herbs, with succulent but not fleshy herbage, watery juice, alternate palmately ribbed and mostly angled or lobed leaves, pistillate and staminate flowers separate and both kinds generally on the same plant. The calyx is grown to ovary; petals commonly united; stamens usually three, of which one has a one-celled and the others two-celled anthers, but commonly the anthers are much twisted and often all combined into a head, and the filaments are sometimes grown into a column. The fruit is unusually fleshy and the seed is flat and made up entirely of embryo. It is commonly believed that some of the species in this group readily cross, but if it occurs at all it is but rarely, and squash and pumpkins have never been successfully crossed with melons. Besides the squash, pumpkin, muskmelon, watermelon, and cucumbers, whose cultural directions are here given, there occur in this family the gourd and the wild cucumbers of the gardens.

SQUASH (Cucurbita)

The term squash does not signify any botanical division, but is an American name that is applied to a large number of varieties of gourds which in common parlance have come to be classified separately. The term often includes what are sometimes called pumpkins.

The term gourd is applied to all the members of Cucurbita pepo and includes the Scallop and Crookneck squashes, field pumpkins, and the small, very hard-shelled fruits of many shapes and colors borne on slender vines that are grown chiefly as curiosities under the name of gourds. The latter are what are commonly known as gourds.

Pollenizing the Flowers.—The flowers resemble those of the cucumber and melon, being separate on the same vine. The pistillate flower is produced at the end of the miniature squash; the staminate flower is often called the "false blossom," and its office is to produce pollen only. They are naturally pollinized by insects.

The crop is made more certain by having bees near by to pollinize the flowers. In some places, the absence of many insects is the reason why cucumbers, melons, and squashes, which are similar in the construction of their flowers, fail to produce much fruit, though the vines may grow freely. This is a common complaint in some new prairie sections, as there is often a deficiency of pollinizing insects in such places. Where small cucumbers, squashes, and melons fall off and fail to mature, this matter of pollination should be closely studied, and if insects are not present the work can be quickly and easily done by hand. For this purpose a rather large camel's hair brush is used, which can be filled at one time with enough pollen from a few male flowers to pollinize twenty or more female flowers.

Fig. 123. Flowers of the squash; at the left, two staminate (male) flowers; at the right, two pistillate (female) flowers.

The seed is oval and flat, generally white or yellow, but varies greatly in size. There is a common belief among gardeners that vines from old seed do not grow as strong as those from new seed, but produce more fruit. This seems to be borne out by some experiments.

Cultivation.—The cultivation of the squash and the pumpkin is much the same as for cucumbers. About six seeds should be put in each hill. The hills should be eight feet apart each way for the longer-growing kinds, and five feet apart for the bush sorts. The plants should be thinned out after they are established so as to allow two plants to each hill. They are affected by the same insect pests as the cucumber, and the same remedies are in order. In addition, however, to these, some kinds are affected in the Eastern states by a borer that works in the stem, and by the squash bug. (See chapter on insects.)

The early varieties of the squash are sometimes started in hotbeds or cold frames to advance them and thus avoid serious injury from the striped beetle.

Harvesting.—Summer squash are not grown for storing and are not desirable for table use except before the skin hardens, when they are used entire. Winter squash are excellent for use in a green state but are not gathered for storing until the skin is hard. They should always be gathered upon the approach of frosty weather, as a very little frost injures their keeping qualities, although the injury may not be apparent when gathered. It is a good plan in harvesting them to place them in piles in the field, leaving them exposed to the sun during the day and covering them with the vines or other material every frosty night until they are thoroughly dried and the skins have become hard and flinty. In gathering, cut the stem off not over an inch from the squash, for if the stem is left on it is likely to be used as a handle and be broken off and thus leave a spot that is very sure to start to rotting. Squashes should be handled with the greatest care if they are to be kept successfully, and each one should be placed in the wagon or on the shelf separately; if handled roughly they will not keep. They should be carried in a spring wagon or on a bed of hay or straw.

Storing.—Winter squash keep best in a dry atmosphere and at a cool temperature. They will, however, keep well in a warm or even hot cellar or room, providing it is dry, but will quickly rot in a moist atmosphere. They will shrink more in weight in a warm than in a cool place. They should be laid on shelves one tier deep, and never piled up if it is desired to keep them long. When well hardened without exposure to frost before storing, and

Fig. 124. Squashes in winter storage.

kept dry, many of the winter sorts are easily kept until March, or even with some success as late as May.

The quality of squash varies somewhat according to the land on which it is grown. Sandy loam is generally believed to produce the best flavored dry-flesh squash, but the quality also varies according to the season.

Summer Varieties (*Cucurbita pepo*).—Summer Crookneck is a summer sort, generally with a crooked neck, that is highly esteemed. A form of this with a straight neck is also grown.

Bush Scalloped.—Yellow and white varieties of this for summer use are much grown by market gardeners, differing from each other only in color of the skin. They are round-flat and have a scalloped edge.

Boston Marrow.—Much grown for marketing and very highly esteemed for summer and fall use.

Orange Marrow.—A form of the Boston Marrow.

Fall and Winter Varieties (*Cucurbita maxima*).— Hubbard.—This is the best known and most largely grown of

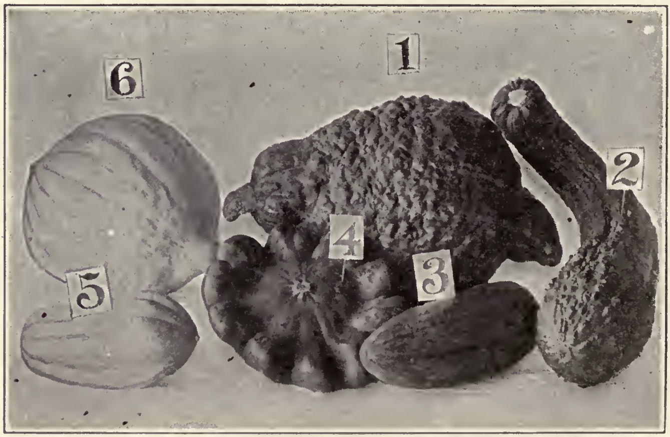

Fig. 125. Varieties of squashes; *1*, Hubbard; *2*, Summer Crookneck; *3*, Marrow (variety); *4*, Scallop; *5*, Marrow (var.); *6*, Golden Marrow.

the winter varieties. It varies somewhat in form, is generally dark green in color and sometimes marked with red. When well grown it has a rough shell of flinty hardness and thick, heavy flesh that cooks dry. The quality varies much according to the quality of the land on which it is grown, sandy loam generally producing the best.

Marblehead is a variety that resembles the Hubbard in quality of flesh, and by many is considered superior. It differs from the Hubbard in form and color, is ashy gray, and the flesh is much thinner. It yields less in weight but generally produces more squashes per acre.

Essex Hybrid.—Very fine grained, rich, sweet, and a good keeper; excellent for autumn and winter.

Winter Crookneck.—One of the hardiest, most reliable, and best-keeping squashes, but in quality no better than some of the pumpkins. Very little in demand for marketing, but popular in some sections for home use.

PUMPKIN (*Cucurbita pepo*)

Description.—Native of warm climates. An annual. Under the name of pumpkin are grouped a number of gourds, greatly varying in shape, color, size, and quality. Some of them are very good for cooking purposes, but they are not generally esteemed for table use by those who have become accustomed to the better kinds of squashes; some of them are great yielders and are used for feeding cattle. They may be grown as recommended for squash or, as is most commonly practiced, grown with corn, where the seed is planted as soon as warm weather is assured. The seed varies much in size. For remarks on its flowers and pollination see squash, with which they are nearly identical.

Fig. 126. Cheese pumpkin.

Varieties.—The variety most generally grown is known as Connecticut Field, which is of large size and is used mainly for feeding stock. Sugar and Cheese pumpkins are varieties much grown for cooking purposes.

MUSKMELON (*Cucumis melo*)

Description.—Native of the warm parts of Asia. An annual. It has been cultivated from a very remote period of antiquity. It resembles the cucumber in habit of growth, and, like it and the squash, the different sexes of flowers

Fig. 127. Muskmelons; *1*, California Citron; *2*, White Japan; *3*, Miller's Cream; *4*, Extra Early.

are separate on the same plant and in nature require the agency of insects to pollinize them; however, they may be pollinized by hand, and the directions for pollinizing cucumber flowers apply here. In quite a few cases the flowers of the muskmelon are perfect, that is, have both stamens and pistils; but it is likely that even in these cases cross-fertilization is necessary. The seed resembles cucumber seed in size and form. The fruit varies in shape but is commonly round or oval. The flesh varies in color from nearly white to deep orange.

Muskmelon is one of the most healthful and delicious of fruits, and our warm, bright summers are especially favorable to its growth. As far north as Minneapolis, this fruit is often so plentiful as to glut the markets in September. It is grown in large quantities in Colorado, Indiana, Illinois, Georgia, Texas, and New Jersey and shipped to Northern markets.

Culture.—The culture of muskmelons is practically the same as that recommended for cucumbers, and the insect pests are also the same. A warm soil is, if anything, more desirable for this crop than for cucumbers, and in moist seasons it does especially well on very sandy land, providing it has been well manured.

In common with other vegetables it is important that only good seed be used for growing muskmelons. Large amounts are raised in Colorado, New Jersey, and California. Some of the Southern growers make it a practice to send to Colorado every year for special varieties, such as Rockyford. They find they have better results than when growing it on their own places.

It is a good plan to pinch off the ends of the vines, after they have grown several feet, for the purpose of forcing out the laterals on which the fruit is borne, although this is not customary in growing them on a large scale. Late settings of fruit may be removed to advantage in September, as they then have not time to mature.

Harvesting.—The fruit is not ripe until the stem separates easily from it. Fruit ripened on the vine is of the best quality, but for shipping purposes it should be picked when still green. Almost without exception, melons with finely netted skins are of better quality than those with smooth or coarsely netted skins. So true is this that buyers often refuse to buy the smooth kinds. In order to make the fruit ripen earlier and to avoid the attacks of the striped beetle, the plants are often started in pots and on sods in hotbeds or frames, as recommended for cucumbers. It is a good plan also to place a piece of glass or board under the melons when those of the best quality are desired, since this keeps them off the ground, and they ripen more evenly in consequence.

Yields.—Yields vary in different sections of the country; from one hundred to two hundred crates of forty-five melons each is probably a good average yield.

Varieties.—Melons vary much in size, form, color of skin and flesh, and in quality. The New Hampshire experiment station,* has made some eight groups of American muskmelons. Among the more important melons of these groups are:—

Rockyford, a melon having light-green flesh of smooth texture, grown in all melon sections, and an excellent variety for home and market use.

Montreal, or Montreal Beauty, is grown in Canada for market and occasionally in home use. Fruits are large and of fine quality.

Osage or Miller's Cream.—A large melon having firm salmon-colored flesh, is very productive, and highly esteemed for the market and home garden. It is perhaps the best shipping sort now grown.

Emerald Gem is a very prolific melon, with small but very superior fruit that is valuable for home use; green fleshed.

WATERMELON (*Citrullis vulgaris*)

Description.—Native of Africa. An annual. A vine of the same general habit as the muskmelon, but the leaves are deeply lobed, and the whole plant is covered

*Technical Bulletin No. 2.

with soft, grayish hairs that give it a grayish aspect. The flowers are the same in general structure as those of the cucumber or muskmelon. The seeds are large but vary much in size, color and markings. The fruit varies in color of skin from pale yellow to deep green and is often mottled; the flesh varies from white to pink or yellow. Some are tasteless and insipid and others are sugary and

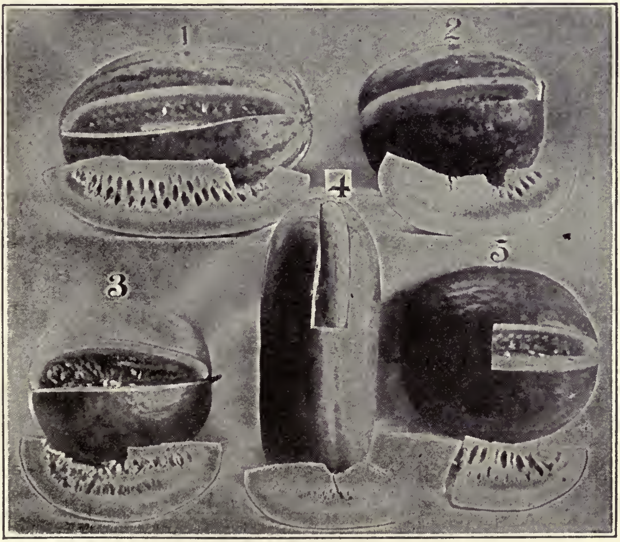

Fig. 128. Varieties of watermelons; *1*, Iron Clad; *2*, Cuban Queen; *3*, Light Ice Rind; *4*, Monte Cristo; *5*, Dark Ice Rind.

refreshing. The fruit often weighs as much as fifty pounds, in good seasons when grown in favorable locations, even in the extreme Northern states.

Culture.—The method of culture is the same as for the cucumber and muskmelon, with the exception that the vines should not be pinched, and they require rather more room in which to grow. They should be planted about eight feet apart each way.

Harvesting.—Watermelons must be harvested at the right time, if they are to be shipped to market. Large quantities are grown in the Southern states for shipping north. Indiana Bulletin No. 123 shows the number of melons of any given size that can be loaded on a car.

Varieties.—There are many kinds of watermelons offered by seedsmen, differing from one another in many particulars. Several of the most esteemed are the following:

Dark and Light Icing, or Ice Rind.—The best two varieties for general use. Well adapted for home use or marketing.

Cole, is a small early-ripening melon grown in the North. Kleckly Sweet is a melon of good quality and largely grown.

Citron, or Preserving Melon.—This resembles watermelon, but the flesh is hard and fit only for preserves. There is but a limited demand for it.

CUCUMBER (*Cucumis sativus*)

Description.—Native of the East Indies. Annual. A creeping plant with angular, flexible stems, rough to touch and furnished with tendrils. The flowers are yellow, in the axils of the leaves, some male, others female; the latter flowers are on the ovary, which later becomes the cucumber. The plants produce flowers and fruit in succession over a long season, and these are naturally pollinized by insects. The seed is long-oval in form and yellowish-white in color. There are two types of fruit, the long or English variety used in greenhouses, and the short or White Spine type used both indoors and outside.

Cultivation.—The soil for cucumbers should be a deep, rich, somewhat retentive loam; and yet this vegetable will do very well with only moderately favorable conditions. For ordinary use and for the home garden, cucumber seed should be planted after the ground is warm, say from the middle to the last of May, but it may be planted with good results as late as the middle of June.

It is quite customary to furrow out the land six feet apart one way, mark crossways of the furrows with a six foot marker, and put a shovelful of well-rotted manure or

Fig. 129. Chicago pickling cucumber.

compost in each intersection. Cover this manure with soil and plant the cucumber seed. Of course, when the land is in the best condition, it is not necessary to put manure in the hills; in such cases, all that is necessary is to mark out both ways and plant at the intersections. About ten or a dozen seeds should be put in each hill and covered about one inch deep, and the soil packed over the seeds.

As soon as the plants are up, and after each rain, they should have the soil loosened around them. They should also be kept dusted, until well established, with Paris green, land plaster, or some other dust, to keep off the striped beetles, which are often very troublesome and may destroy the plants when they are small unless preventive measures are used. (See chapter on insects.) The land should be cultivated both ways until the vines prevent it, so that very little work will have to be done by hand. About three good plants are enough for each hill, and the rest should be removed after the danger from serious insect injuries has passed.

Gathering the Crop.—If for table use or for marketing in a green state, the cucumbers are gathered when full grown but still green; if for pickles, the cucumbers are gathered as soon as of the required size, which is generally when they are about three inches long. Some factories put up larger and some smaller pickles than this size. To gather them of just the right size requires that the whole bed be picked over about once in two days. This is a matter of much labor and is generally paid for by the piece.

No cucumbers should be allowed to go to seed if pickles or table cucumbers are wanted, for as soon as seed is ripened the plants commence to die off; while if constantly gathered when green and not allowed to ripen, the plants will continue bearing a long time. In the vicinity of pickling factories, cucumbers for pickles are often raised in large quantities as a farm crop and are contracted for at a specified price per thousand or per hundred pounds, for the season.

For home use or for storing and marketing in the winter, the cucumbers are packed in salt or salt brine when gathered. Growers generally use about seven pounds of salt to a bushel of cucumbers. They may also be packed in dry salt in layers, which has the effect of taking the water out of the cucumbers, causing them to shrivel up and lie in their own juice. When wanted for use they are freshened out in water, which causes those that are shriveled to swell up plump; they are then put in vinegar. Cucumber pickles are easily kept until the following spring in this way, but when kept later than spring they get soft and are not so desirable. Cucumbers will stand a great amount of dry weather without injury, if frequently cultivated.

Starting cucumbers in cold frames and hotbeds and then transplanting them to the open ground when all danger of frost is over is a common practice where they are wanted for early use. Under this system the seed is sown in old strawberry boxes, tomato cans, flower pots, etc. Square pieces of inverted sod are also used for the same purpose, four or five seeds being sown on each piece five inches square and covered with good soil. The plants in this latter case root into the sod and are easily moved.

Starting cucumbers this way has the merit of advancing the period of maturity of the plants, and as they are well started when set out there is little danger of attacks of the striped beetle, and the fruit is earlier than when sown in the open ground. In following out this plan, the seed should not be sown before the first of May, or the plants will be too large to move well. Before the plants are removed from the frames to the open ground, they should be exposed without the sash for several days until well hardened off. When these plants are moved to the open ground, they should be set rather deeper than they grew in the frames. They then are cultivated the same as plants from seed sown in the hill.

Another way for advancing the cucumber season when hotbed sash is used, is by planting a hill of them very early in the center of each sash of the hotbed, using the rest of each sash for an early vegetable crop. The cucumbers will not need much room for several weeks, which will give time to grow the early crop and get it out of the way of the cucumbers. The sashes should be removed when warm weather comes, and the vines allowed to grow in the frames all summer.

Yields.—Cucumbers yield from one hundred to four hundred or more bushels per acre, depending on care, soil, etc. They are sold by the dozen, the bushel, or by weight, bringing from twenty-five cents apiece to twenty-five or fifty cents per bushel, depending on the supply. A good field ought to return from $200 to $300 an acre for slicing cucumbers. Yields of picklers vary from three to nine tons per acre, and bring from $12 to $15 per ton.

Insects.—The cucumber has a serious enemy in the striped beetle and is also liable to injury from the cut-worm. (For remedies see chapter on insects.)

Seed.—Cucumber seed is easily raised, and in some localities it is a product of some importance. In raising seed it is important to save it from the early fruit, which in a small way is easily saved; on a large scale, however, the fruits are allowed to ripen but not to rot on the ground. When the vines are dead, the ripe cucumbers are split open, the pulp scooped out with the seed and allowed to ferment for a few days, when it readily separates from the seed. The whole mass is then thrown into a sieve with a mesh small enough to retain the seeds as the pulp is washed through, leaving the clean seed, which is carefully dried. If the cucumbers are allowed to get rotten before the seed is taken out, the skins will become mixed with the seed, and the seed will be discolored, and such seed is very liable to sprout in the cleaning and curing process.

Varieties.—For general home use and marketing, the White Spine is a favorite variety. For pickles, the most profitable kinds are those producing many small cucumbers, such as the variety known as the Boston Pickling. There are many good varieties of cucumbers and they are offered under various names. For earliest use the Early Russian is perhaps the best, but it is small and seedy.

THE SUNFLOWER FAMILY (Order Compositae)

The Sunflower Family is the largest group of flowering plants, yet it has given us only a very few garden vegetables and those are of little importance. Its plants are distinguished by what the older botanists termed the "compound flower." This consists of several or many flowers in a head, surrounded by a set of bracts. Stamens are as many as the lobes of the corolla (generally five), their anthers grown together by their edges. The ovary is one-celled, inferior, containing a single seed. Besides the artichoke, lettuce, salsify, endive, and dandelion, whose cultural directions are here given, there occur here the tansy, sunflower, daisies, corn-flower, Ageratum, Cineraria, chicory, burdock, thistle, wild lettuce, compass plant, ragweed, fireweed, chrysanthemum, marigold, goldenrod, aster, yarrow, zinnia, dahlia, and many other well-known plants.

LETTUCE (*Lactuca sativa*)

Description.—Native of India or Central Asia. An annual. Flowers are yellow, on seed stalks two or more feet high; seeds small, flat, white or black, but sometimes yellow or reddish-brown in color. The shape and size of the leaves also vary greatly: sometimes they form a head like the cabbage, and again only a loose bunch. The foliage is generally of some shade of green, but some varieties have leaves of a reddish color.

Cultivation.—Lettuce is largely grown in greenhouses during the winter, in hotbeds and cold frames in the early spring, and outdoors in the late spring and until severe weather in autumn. It is a very important crop for the market gardener, as there is some demand for it at all seasons of the year and a large call for it in the spring. Some growers making a specialty of this crop have it in marketable condition every month of the year. In some sections, the plants may be started in September and when of good

Fig. 130. Black-seeded Simpson lettuce. (A typical curly sort.)

size transplanted to a cold frame, where they may be safely wintered over. In the spring they are planted in hotbeds and in the open ground. In the extreme Northern states, however, although plants frequently come through the winter safely when thus protected, it is not a method to be depended upon. It is customary here to raise the plants for spring planting in greenhouses or early hotbeds.

Lettuce may be transplanted to the open ground as soon as the soil will work easily in the spring, but it should be well hardened off before being planted out; it will, however, stand quite a severe freeze if properly hardened off, and, as is the case with many other crops, the plants may be protected with earth on the approach of hard frost, providing it does not remain over them more than a day or two. In the open ground, lettuce plants should be set out about twelve inches apart each way. It is frequently grown between rows of early cabbage, cauliflower, or other plants where it fills up otherwise unoccupied space and comes off the land long before other crops need the room it occupies. For late use the seed is often sown in the open ground in drills one foot apart and the plants thinned to the same distance apart. It is customary also in the home garden to sow the seed and then cut off the young plants as soon as they are large enough to use; such lettuce, however, is not nearly so good as head lettuce, where the center is white, crisp, and tender. It is a far better plan to thin out the young plants so that they stand three or four inches apart in the rows, and, in cutting, continue the thinning process so that the later plants will form good heads. Of course, it is necessary to make successive sowings of lettuce in order to have it fit for table use over a long season. Like all leaf crops, lettuce needs plenty of rich, easily available nitrogenous manure, and responds very quickly to small applications of nitrate of soda.

Seed.—Most of the seed of lettuce used in this country comes from California. Several hundred acres are grown there for seed. It is said thirty to sixty plants will produce a pound of seed. Great care should be exercised in the purchase or growing of lettuce seed if large quantities of lettuce are to be grown.

Varieties.—There are many varieties, and each year finds many additions to the list of those offered by seedsmen. In the matter of quality, those forming a head like the cabbage have the preference. Varieties that form only a bunch of leaves are largely raised by market gardeners to supply the common demand, since they are more easily grown and are less liable to injury in handling than the heading varieties. Some of the most desirable kinds are as follows:—

White Tennis Ball, or Boston Market.—A very popular market variety adapted for hotbed and early spring use

Fig. 131. Head lettuce.

only. It forms a solid head of medium size but quickly goes to seed in warm weather.

Hanson.—Forms large solid heads and is a general favorite; excellent for spring or summer use.

Black-Seeded Simpson.—A popular forcing variety that stands well without going to seed and does not form a head but a mass of curled leaves.

Grand Rapids.—A very desirable lettuce for forcing. It resembles Black-Seeded Simpson, but is a better shipping variety.

Black-Seeded Tennis Ball.—A popular sort for forcing or early garden culture. It forms large, solid heads and is highly esteemed.

Salamander.—A good heading sort for summer use.

Buttercup.—Bright chrome yellow in color, very beautiful; tender and desirable. A popular new sort.

Insects and Diseases.—There are few insects or diseases that seriously affect the lettuce when grown outdoors. In the greenhouse and occasionally in the hotbeds, it is sometimes attacked by the aphis and mildew. For remedies for aphis, see chapter on insects.

Mildew frequently injures the lettuce crop when it is grown in greenhouses in winter. It is most liable to be caused by over-watering and especially by frequent watering in cold or cloudy weather, which keeps the leaves wet much of the time. It is a good plan to water heavily when the crop is planted and to avoid repeating it until the soil is quite dry, and then water heavily again in the morning of a bright day, so that the foliage may dry off before night. Sub-irrigation has been used with excellent success for this crop in greenhouses in winter.

SALSIFY, OR VEGETABLE OYSTER (*Tragopogon porrifolius*)

Description.—Native of Europe. A biennial. A plant with long fleshy tap root and grass-like leaves. The flower stalks grow three feet high; the seed is long, ridged, generally curved, and pointed at both ends. It is rather difficult to plant with a seed sower because of its peculiar form, but when the points are rubbed off it is often so planted.

Culture.—The cultural directions given for the parsnip apply to this plant. It is very easily grown and is hardy, and generally comes through the winter in the extreme Northern states without injury; it is safer, however, to dig the roots in autumn, and put in pits until spring or for use during winter. The root is highly esteemed and has a flavor of oysters; it is used for soups, but may be cooked in the same manner as parsnips.

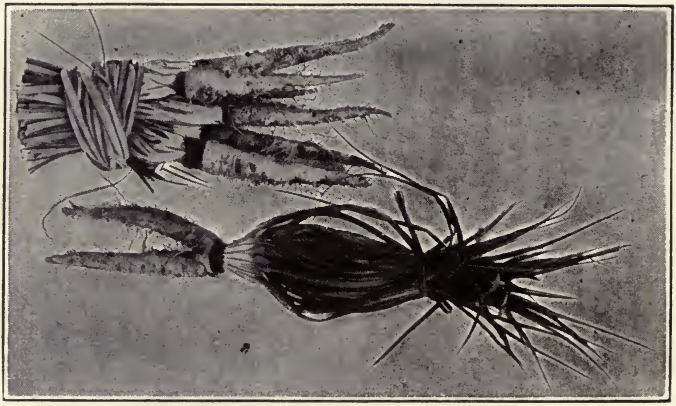

Fig. 132. Salsify—a single plant and a bunch for market.

The best variety is the Mammoth Sandwich Island, which is far superior to any other.

ENDIVE (*Cichorium endivia*)

Description.—Native of East India. An annual. Endive resembles the dandelion in habit and growth. It is esteemed by some as a desirable fall and winter salad, since it has a pleasant bitter taste when blanched.

Culture.—It is of very simple culture and may be grown in much the same manner as lettuce. For summer use, sow the seed early in the spring; for autumn and winter use, sow in July. It is blanched before being eaten. This is accomplished by tying the leaves tightly together when the plants have nearly completed their growth.

After this treatment, the leaves in the center of the plant will have become blanched in about three weeks. Do not tie the plants too rapidly, since the hearts are liable to rot soon after blanching, especially if the weather is warm. On the approach of severe weather, the plants may be set in boxes in a cold cellar, where they will continue to produce nice blanched leaves during the early part of the winter.

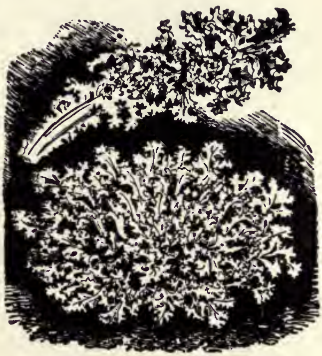

Fig. 133. Curled endive.

Varieties.—A variety known as Green Curled endive is generally grown, but other varieties are offered by seedsmen.

DANDELION (*Taraxacum officinale*)

Description.—Native of Europe. A perennial. The dandelion is a familiar plant to almost every one. It is now of spontaneous growth here and is used for greens in its wild state, but the cultivated varieties are quite an improvement on the wild plants.

Culture.—The best method of growing it is by sowing the seed in the spring in drills ten inches apart and thinning out the plants to three inches apart in rows. The seed is somewhat difficult to start, and it is a good plan to go over each row twice with the seed sower, so as to mix the seed up with the soil, since by this method some of it will be sure to be properly covered. It is sometimes used in the fall, but not generally until spring. It is often forced by covering the bed with the hotbed sash or by transplanting to hotbeds or cold frames.

Fig. 134. Dandelion.

Dandelion is sometimes blanched and used as a salad, for which purpose it is much like endive. While the plant is a perennial, yet only one crop should be harvested from each sowing, since after the first cutting many sprouts are produced from each root, none of which are large enough for good market plants. The plants should always be plowed in before they ripen seed unless seed is to be saved, to prevent its scattering and becoming a nuisance. A variety called the Improved Thick-Leaved is the most esteemed.

JERUSALEM ARTICHOKE (*Helianthus tuberosus*)

Description.—Native of North America. A perennial. Stems herbaceous, six or more feet high; roots tuberous. Flowers are yellow, resembling those of the common sunflower, but comparatively small.

Culture.—For best results the artichoke requires exceedingly rich soil. It can be grown from the seed, although this is seldom attempted, but it is customary to grow it by planting the small tubers whole or cutting the large tubers in the same way as potatoes. They should be planted about four inches deep at twelve-inch intervals in rows three feet apart. They are used chiefly for feeding stock and are often harvested by turning hogs into the field. They will frequently remain in the land many years even if not cultivated. They are easily injured by frost when not covered with earth, but in the ground they are perfectly hardy.

GLOBE ARTICHOKE (*Cynara scolymus*)

Description and Culture.—Native of Barbary and South Europe. A perennial. This is a large thistle-like plant growing two to three feet high, producing large flower heads, the scales of which are large and thick and are highly esteemed as a garden vegetable in England and southern Europe. It has, however, never become popular in this country, and is rarely grown. In southern Europe it is grown by divisions, and there are many varieties. It may also be grown from seed, but seedlings are generally very much inferior to other sorts. The roots must be very carefully protected in order to bring them through Northern winters.

REVIEW QUESTIONS

1. How may vegetables be classified, and name five in each class.
2. What is meant by frost-tender vegetables? Frost-hardy?
3. Discuss the cultivation of mushrooms.
4. Of what country is corn a native? Into what four classes may the varieties be grouped?
5. Discuss the cultivation of sweet corn.
6. Name five varieties each of early-and late-maturing sweet corn.
7. How may sweet corn be cured and preserved?
8. What is corn smut?
9. What is asparagus, and of what country is it a native?
10. How is asparagus propagated and cultivated?
11. How should asparagus be cut and marketed?
12. When and how should the asparagus bed be manured?
13. How may asparagus be forced for early market?
14. Of what country are onions native? How are they propagated?
15. How should the land be prepared for onion raising?
16. Discuss the sowing of onion seed.
17. How should onions be cultivated?

18. What are "scallious" onion sets?

19. What are the methods of keeping onions over winter?

20. What are the advantages of planting onion sets?

21. How are they cultivated and gathered?

22. Discuss the transplanting of onions.

23. Name two varieties grown from seed, two for sets, two for transplanting.

24. What are "shallots?" "Egyptian onions?" "Top onions?"

25. How is onion seed obtained?

26. What are leeks, garlic, chives, and how are they cultivated and propagated?

27. How is rhubarb propagated?

28. What cultivation does rhubarb need?

29. What is the method used for forcing rhubarb?

30. How are beets propagated and cultivated?

31. Describe a beet seed.

32. How should they be harvested and stored over winter?

33. How does scab affect beets, and what precautions should be taken against it?

34. What are stock beets? Sugar beets? Leaf beets?

35. What is spinach, and how cultivated?

36. Of what countries is cabbage native, and into what three groups is it divided?

37. What vegetables have sprung from the original species of cabbage?

38. What soil is best for growing cabbages?

39. How should cabbage crops be manured?

40. Discuss cabbage raising for early crops.

41. How are the plants set out and cultivated?

42. What soil is best for late cabbage crops?

43. What are the advantages and disadvantages of growing cabbages for late crops?

44. When are cabbages transplanted, and how are they set out?

45. How are cabbages sown in the hill cultivated?

46. How are cabbages harvested?

47. What are the methods of storing cabbage?

48. How is cabbage seed obtained?

49. Name two desirable early varieties and two late varieties.

50. What diseases and insects affect cabbage?

51. How does clubroot affect cabbages, and what is the remedy for it?

52. What is black rot, and how does it affect cabbage plants?

53. Give five means of preventing it.

54. How is sauerkraut made?

55. What are Brussels sprouts?

56. What is cauliflower and how is it cultivated?

57. What is kale and kohl-rabi and how cultivated?

58. Of what countries are turnips native?

59. When and in what kind of soil should turnip seed be sown?

60. How are rutabagas cultivated and stored?

61. How is horse-radish propagated and cultivated?

62. Describe water cress and how it is cultivated.

63. How are winter radishes grown and stored?

64. What insects affect radishes, and what are remedies.

65. Name five good varieties of radishes.

66. What are the characteristics of the clover family, and what are some of its species?

67. Into what two classes are beans divided, and give characteristics of each?

68. How are bush beans cultivated?

69. How are beans harvested?

70. Name five good varieties of fall beans.

71. How are pole beans cultivated?

72. What is the result of transplanting beans?

73. What is a good way of preserving beans?

74. How prevent diseases and insects from injuring beans?

75. Into what three classes are peas divided, and in what ways do the classes differ?

76. How are peas cultivated?

77. Name five good varieties of peas.

78. What is okra, and how is it cultivated?

79. What are the characteristics of the parsnip family?

80. How are parsnips cultivated?

81. How are parsnips marketed?

82. What is parsley, and how is it cultivated?

83. Discuss the cultivation of carrots.

84. How are they gathered and stored?

85. How is carrot seed gathered?

86. What kind of soil is necessary for a good celery crop?

87. How should celery be planted to obtain an early crop?

88. How should celery be planted to obtain a late crop?

89. How is celery cultivated?

90. How are the plants transplanted?

91. How are celery and onions planted out together?

92. What is meant by "handling" celery?

93. What is the process of blanching or banking?

94. How is celery blanched with boards, and why not as profitable as banking with soil?

95. What is a convenient way of planting celery for easy cultivation and weeding?

96. When and how should celery be dug?

97. Discuss a good method of storing celery.

98. How long does it take celery to blanch in the field and in the cellar?

99. How is celery seed raised?

100. What diseases are most common in affecting celery?

101. How are they treated?

102. Name five good varieties of celery.

103. What is celeriac, and how is it cultivated?

104. To what family does the sweet potato belong?

105. How is the sweet potato cultivated?

106. What plants belong to the potato family and what are their general characteristics?

107. What colors of skin and flesh, and what forms do we find in potatoes?

108. How is the potato propagated?

109. When and how was the modern potato originated?

110. What kind of soil is best for potatoes?

111. How should such land be manured?

112. What are "sets," and what are the qualities of a good "set"?

113. How are potatoes planted, and what kind should be selected for seed?

114. How are potatoes treated for early planting?

115. How is the main crop of potatoes cultivated?

116. Discuss the digging and storing of potatoes.

117. What is the average per acre of marketable potatoes in the Northern states? What are the biggest yields known?

118. Name five good varieties of potatoes.

119. Discuss the propagation of potatoes.

120. What insects and diseases are injurious to the potato?

121. How and when does scab affect potatoes?

122. What is the best treatment for early potatoes?

123. How does potato blight affect potatoes?

124. What is Bordeaux mixture and how is it applied?

125. What is internal brown rot?

126. How are eggplants cultivated?

127. When should tomato seed be sown and transplanted?

128. What kind of soil is best for tomato growing?

129. How should tomato plants be pruned and trained?

130. How may the tomato season be prolonged after frosts come in autumn?

131. How should tomatoes be selected to save for seed?

132. Name five good varieties of tomatoes.

133. What is tomato rot, and what are the best remedies for it?

134. What are ground cherries, and how cultivated?

135. What are the characteristics of the peppers, and for what are they used?

136. What is martynia, and how is it cultivated?

137. What are the general characteristics of the gourd family?

138. How are the flowers pollinized?

139. How are squashes cultivated?

140. Discuss the harvesting and storing of squashes.

141. Name three good summer varieties and three good winter varieties of squash.

142. What are pumpkins?

143. What are the general characteristics of the muskmelon, and how cultivated?

144. How do the different varieties vary?

145. What is the difference between a muskmelon and a watermelon?

146. Name three good varieties of watermelon.

147. Of what country is the cucumber a native?

148. How is it cultivated?

149. What soil is best for raising cucumbers?

150. How should they be gathered when to be used for pickles.

151. How should they be gathered for home use?

152. How may they be stored for winter?

153. How are cucumbers and melons started for early crops?

154. How are cucumbers cultivated?

155. What insects injure cucumbers and melons?

156. How are cucumbers gathered for seed?

157. Name one good variety for home use and one for pickling.

158. What are some of the plants that belong to the sunflower family?

159. How is lettuce cultivated?

160. Name three good varieties for spring use and three for summer.

161. How does mildew affect lettuce, and how may it be prevented?

162. What is salsify, and how is it cultivated?

163. How is endive cultivated?

164. How are dandelions planted and cultivated?

165. How is the Jerusalem artichoke cultivated, and for what is it used?

166. What is the globe artichoke?

CHAPTER X

GARDEN HERBS

Under the head of garden herbs are grouped a number of sweet culinary and medicinal plants that are cultivated to some extent in gardens. They are generally easily grown in mellow, open soil. Those having foliage that is esteemed for its aroma should generally be cut on a dry day, just as they reach full flowering stage, and should be dried quickly in the shade. As a rule, herbs should be cut before being frozen, though freezing does not always injure them. When dry they should be kept in dry, air-tight boxes or vessels. The demand is very limited for most of them. Only a few of the most common kinds are mentioned here. In the extreme Northern states, many of the perennial kinds will kill out in severe winters unless protected.

THE MINT FAMILY (Order Labiatae)

The Mint Family includes little other than herbs (with few exceptions) which have aromatic herbage, square stems, opposite, simple leaves, 2-lipped corolla, and a deeply 4-parted ovary, which separates into the same number of seeds. Besides balm, catnip, lavender, peppermint, sage, sweet basil, sweet marjoram, spearmint, summer savory, thyme, and winter savory, whose cultural directions are here given, this order includes garden coleus, hyssop, flowering sage or salvia, and horse mint. The plants of this group are mostly grown for their aromatic herbage.

Balm (*Melissa officinalis*).—A native of the south of Europe. Perennial. A plant growing about eighteen inches high having aromatic herbage. The seed is very small. Sow in spring where the plants are to remain.

Fig. 135. Characteristic portions of garden herbs; *1*, catnip; *2*, balm; *3*, wormwood; *4*, summer savory; *5*, thyme; *6*, hoarhound; *7*, sage; *8*, saffron; *9*, sweet basil; *10*, sweet marjoram (American); *11*, rue; *12*, dill; *13*, sweet fennel.

Catnip (*Nepeta cataria*).—Native of Europe. Perennial. Often a common weed around buildings and along roadsides here. It is used in a small way for seasoning. Easily grown from seed or by division.

Lavender (*Lavendula spica*).—Native of southern Europe. Perennial. A low undershrub grown chiefly for its flowers, which are used in the manufacture of perfumery. Generally increased by dividing the old roots. It delights in a fine, rich, rather calcareous soil.

Peppermint (*Mentha piperita*).—Native of northern Europe. Perennial. Propagated by division of the stems; occasionally a roadside weed in moist places. It is cultivated in the same way as spearmint. Used mostly for its essential oil, which is obtained by distillation. The raising of this plant forms a considerable industry in a few locations in the Northern states.

Sage (*Salvia officinalis*).—Native of southern Europe. Perennial. Plants forming broad tufts about sixteen inches high; flowers in heads of three or four in terminal clusters, usually bluish white but sometimes white or pink. The seeds are round and of medium size. Plants come readily from seed, which should be sown in early spring. It is customary in a small way to sow the seed outdoors and allow the plants to remain where they grow for several years. Where it is grown on a large scale, however, the plants are generally put out as a second crop, following early peas or cabbage. There is some uncertainty about its coming through very severe winters in the Northern states, but it generally does so in good shape; it is more reliable if banked with earth or covered with litter in winter. Broad-leaved sage is an improved kind.

Fig. 136. A branch of sage.

Sweet Basil (*Ocymum basilicum*).—Native of India. Annual. Stem about one foot high; very branching. The leaves and other green parts have an agreeable aromatic odor and are used in seasoning. Sow indoors in March or April and transplant as soon as the weather is settled. It may also be sown in the open ground early in the spring.

Sweet Marjoram (*Origanum marjorana*).—Native of Asia. A perennial, but generally grows as an annual. The leaves and other green parts are used for seasoning. The seeds are very small. Sow early in spring in any good garden soil.

Mint or Spearmint (*Mentha viridis*).—Native of Europe. A perennial. A plant with vigorous creeping root stock, very hardy, and sometimes a troublesome weed in moist soil. It is grown by planting the roots in the spring. There is a small demand for this plant in winter as well as in summer, which is met by a greenhouse supply. The leaves and young shoots are used for seasoning.

Summer Savory (*Satureia hortensis*).—Native of southern Europe. An annual. A small plant eight or ten inches high. The seed, which is very small, should be sown the latter part of April or in May. The leaves and young shoots are used for flavoring.

Thyme (*Thymus vulgaris*).—Native of southern Europe. A perennial. A small plant with small aromatic leaves and stems. It starts easily if sown in early spring. It is customary to sow the seed where the plants are to remain but it may be transplanted. It is in demand for flavoring and is generally hardy at the north. Broad-leaved thyme is the only variety worth growing.

Winter Savory (*Satureia montana*).—Native of southern Europe. Perennial. Stems woody, at least near the base; twelve to sixteen inches high. Used for the same purposes as Summer Savory. Not hardy in the North unless well protected.

PARSNIP FAMILY (Order Umbelliferae)

(For characteristics see page 231.)

Anise (*Pimpinella anisum*).—A native of Asia Minor. An annual. Attains a height of sixteen inches. The seeds are aromatic and are used in medicine and in confections. Sow in April or May where the plants are to remain during the season.

Caraway (*Carum carui*).—Native of Europe. A biennial. Stem straight, two or three feet high. The seeds resemble those of carrots and are esteemed for flavoring. It should be sown in May in drills and does not produce seed until the following season; very hardy and of the easiest culture.

Coriander (*Coriandrum sativum*).—Native of southern Europe. An annual. Two to two and one-half feet high. Stem leaves much divided. Grown from the seed, which should be sown in the spring. The seed is used for flavoring purposes; the foliage exhales a very rank odor.

Dill (*Anethum graveolens*).—Native of southern Europe. An annual. Height, from two to two and a half feet. It is of the easiest culture. The seed is much used as flavoring for pickles of various kinds. If should be sown in the spring in rows about one foot apart and cultivated the same as carrots. Where the seed ripens, an abundance of plants generally springs up the following year. Botanically this plant is probably same as fennel, but the latter is more in use in the green stage for its foliage.

BORAGE FAMILY (Order Boraginaceae)

Borage (*Borage officinalis*).—Native of Europe and North Africa. Annual. Twelve to eighteen inches high. Used in the manufacture of cordials. Flowers blue, pretty. Of the easiest culture, growing freely from spring sown seeds.

RUE FAMILY (Oder Rutaceae)

Common Rue (*Ruta graveoleus*).—A bushy herb, woody or almost shrubby at its base. The leaves are very bitter and sometimes used in seasoning. Grown from seed or by division of the roots.

REVIEW QUESTIONS

1. What soil is best for garden herbs?
2. How are they gathered and stored?
3. What are the characteristics of the mint family?
4. What is balm? Catnip? Lavender? Peppermint? How is each propagated and cultivated?
5. What is sage, and how is it grown, harvested, and stored?
6. What is sweet basil? Sweet marjoram? Mint? How are they cultivated?
7. What is summer savory? Thyme? Winter savory?
8. What is anise? Caraway? Coriander? Dill? How are they cultivated?
9. What is borage and common rue, and for what are they used?

CHAPTER XI

VEGETABLES FOR EXHIBITION

Governing Points of an Exhibit.—A few years ago exhibitors of vegetables used to vie with one another to see who could show the largest potatoes, beets, or carrots. About nine times out of ten the largest specimens won the prizes, regardless of their value on the market. This order has been changed now in the exhibiting and judging of all vegetables. The points that govern now are, general appearance, market condition, uniformity, and trueness to type. The market condition, as regards size, color, shape, and quality, is perhaps the most important.

Attractive exhibits may be made of vegetables, either alone or with fruits and flowers, if care is used in the selection and preparation of the different kinds for the purpose. Neat, attractive packages should be used in exhibiting.

Growing.—The plant that is expected to produce the best product for exhibition must be grown from the best seed available, have the best kind of soil and environment adapted to its growth, and be given the best attention and cultivation. Good seed is very important; one cannot hope for good vegetables if poor seed is used.

Selection and Preparation for Exhibition.—In general, all vegetables should be selected as near to type as possible, and neither too large or too small. The whole sample must be clean and uniform in every way. Do not wash vegetables. Use a soft brush to get the dirt off, being careful not to bruise or blemish the skin in any way. When the vegetable is perfectly dry it should be wrapped in soft paper (newspaper will do) and packed carefully in a box or other receptacle to carry to place of exhibition. Care should be used in packing and in transporting, that no injury comes to the vegetable from rough handling.

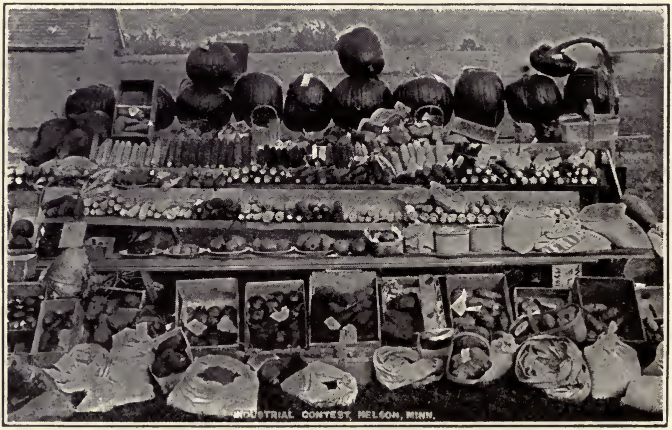

Fig. 137. Industrial exhibit and contest, Nelson, Minnesota.

Amount to Exhibit.—The amount of each kind to show is usually specified by the officers of the exhibition. Potatoes usually are shown in peck, half bushel, or bushel lots, carrots and other roots by number—six or twelve—or by the peck. The amount specified—no more or no less—is usually followed by the judge.

Judging.—Judges usually follow the market requirements in judging vegetables, unless special instructions are given by the management of the exhibition. It is thus important that a judge be very familiar with varieties of vegetables and the market requirements. There are no recognized score cards for the different classes of vegetables except potatoes. A score card used by the Weld County, Colorado, Farmers' Club in judging potatoes is given below. Suggestions for judging a few other vegetables are also given, but as a rule a judge must rely on his knowledge of the vegetable and its value.

WELD COUNTY POTATO SCORE CARD

Exhibits are disqualified: (1) If they have very deep eyes or are irregular in shape. (2) If they show a mixture of different varieties and types. (3) If over 15% are scabby or wormy. (4) If one-fourth are hollow.

The sample must be true to type, unless an improvement of type is shown.

No red potato will score as high as white.

No deep-eyed or long potato is scored as high on shape as if round and smooth.

I Dealers' Scale

Size	20	Too large	2 points off
		Too small	12 points off
		Not even	6 points off
Shape	10		
Appearance	60	Not bright	10 points off
		Dirty	10 points off
		Scabby or wormy	40 points off
Quality	10	Unsound	5 points off
		Brittle or spongy	5 points off

II Final Purchasers' Scale. Knife Examination

Smoothness	5
Pares thin	10
Flesh white	5
Sound, not hollow	5
Cortical layer thick	10
Centers small, not watery	15

III Consumers' Scale. Table Quality

Quickness of cooking	5
Potatoes cook alike	10
Mealiness	20
Whiteness	5
Grain (mashed)	5
Flavor	5

Onions.—Exhibit usually consists of one-half peck of red, white, or yellow varieties. Colors should not compete with one another. The Globe varieties are the best and should always outrank the flat sorts. Evenness, size, ripeness, trueness to type, and color are the points considered.

Carrots.—Exhibit usually consists of six specimens or else a peck. They are classed as table and stock carrots. Stock varieties are the kinds generally grown to feed stock, and should not compete with table varieties. Carrots should be true to type for the variety, clean, bright, tender, uniform, and of good quality. The instructions here apply generally to the root crops.

Cabbage.—Three heads are usually required. They should be firm, uniform, heavy, and of good size.

Beets.—Exhibit consists of six specimens or of a peck. They must be in good condition for table use, medium sized, round or globular, tender, uniform, and in good condition.

Squash.—Three specimens are required. They must be uniform, firm, and true to type and variety. Warty specimens are often preferred to smooth ones.

Pumpkins.—Pumpkins are of two kinds, field and pie. Three specimens of either are required. Field pumpkins should be large, uniform, and heavy. Pie pumpkins must be uniform in size, color, and weight.

APPENDIX

TABLE I—WEIGHT OF ONE QUART OF SEEDS AND NUMBER OF SEEDS IN ONE OUNCE

KIND OF SEED	Weight of a quart of seed in ounces	Number of seeds in one ounce
Asparagus	32	1,400
Balm	20	56,600
Basil	20	22,665
Bean	24 to 33	200 to 225
Beet	10	1,400
Borecole, or Kale	25	8,500
Broccoli	25	10,525
Cabbage	25	8,500
Caraway	15	9,915
Carrot, with spines	9	19,835
Carrot, without spines	13	26,915
Catnip	28	3,400
Cauliflower	25	10,525
Celery	17	70,835
Chicory	14	19,830
Cress, American	20	16,915
Cress, common garden	28	12,715
Cress, water	20⅔	113,335
Cucumber, common	18	1,103
Cucumber, prickly fruited gherkin	20	3,680
Dandelion	9½	34,000 to 42,500
Dill	11	25,500
Eggplant	18	6,520
Endive	12	18,000
Kohl-rabi	25	8,500
Leek	20	11,335
Lettuce	15⅛	22,665
Maize, or Indian Corn	23	113 to 140
Marjoram, sweet	20	113,355
Marjoram, winter	24	340,000
Martynia	10⅛	565
Muskmelon	13	1,560
Okra	22	425 to 510
Onion	18	7,080
Pea	25 to 28½	56 to 142
Pea, gray or field	21 to 28½	142 to 225
Parsnip	....	6,605
Pepper	16	4,205
Pumpkin	9	85
Radish	25	700 to 835
Rampion	28½	3,400
Rhubarb	3 to 4½	1,415
Sage	19½	7,080
Salsify	8	2,835
Savory, summer	18	42,500
Savory, winter	15	70,835
Spinach, prickly-seeded	13½	2,550
Spinach, round-seeded	14⅔	3,135
Spinach, New Zealand	8	280 to 340
Squash, Hubbard	14	93
Squash, Bush Scalloped	15½	280
Ground cherry	23	28,335
Thyme	24	170,00C
Tomato	11	8,500 to 11,335
Turnip	24	12,715
Watermelon	16½	113 to 150

TABLE II—LONGEVITY OF GARDEN SEED WHEN PROPERLY CURED AND STORED

KIND OF SEED	Average Years	KIND OF SEED	Average Years
Balm	4	Martynia	1 or 2
Basil	8	Muskmelon	5
Bean	3	Mustard, white or salad	4
Beet	6	Okra	5
Borecole	5	Onion	2
Cabbage	5	Parsnip	2
Caraway	3	Parsley	3
Carrot	4 or 5	Pea, garden or field	3
Catnip	6	Pepper	4
Cauliflower	5	Pumpkin	4 or 5
Celery	8	Radish	5
Chicory	8	Rampion	5
Cress, American	3	Rhubarb	3
Cress, common garden	5	Rosemary	4
Cress, water	5	Rue	2
Cucumber, common	10	Sage	3
Cucumber, Prickly-fruited Gherkin	6	Salsify	2
Dandelion	2	Savory, summer or winter	3
Dill	3	Spinach, all kinds	5
Eggplant	6	Squash, Hubbard	6
Endive	10	Squash, Bush scalloped	6
Kohl-rabi	5	Ground Cherry	8
Leek	3	Thyme	3
Lettuce, common	5	Tomato	4
Maize, or Indian Corn	2	Turnip	5
Marjoram, Sweet	3	Watermelon	6
Marjoram, Winter	5		

TABLE III.—AMOUNT OF SEED REQUIRED FOR ONE ACRE OR FOR A CERTAIN NUMBER OF HILLS OR FEET OF DRILL.

Artichoke (Jerusalem), 3 bushels of tubers per acre.
Asparagus, 1 oz. to 60 ft. of drill; 4 to 5 lbs. per acre.
Beans (dwarf), 2 bu. to the acre in drills; 1 pint to 50 ft. of drill.
" (pole), 1 qt. to 150 hills; 10 to 12 qts. per acre.
Beets, 1 oz. to 50 ft. of drill, 5 lbs. to the acre in drills.
Cabbage, 1 oz. to 1500 plants. ¼ lb. of seed in beds to transplant upon an acre.
Carrot, 1 oz. to 100 ft. of drill, 3 to 4 lbs. per acre in drills.
Cauliflower, 1 oz. for about 1000 plants.
Celery, 1 oz. to 3000 plants; ½ lb. to the acre.
Corn Salad or Fetticus, 1 oz. to 20 square ft.
Corn—Sweet, 1 qt. to 200 hills; 8 to 10 qts. to the acre in hills.
Cress, 1 oz. to 16 square ft.
Cucumber, 1 oz. to 50 hills; 2 lbs. to the acre in hills.
Eggplant, 1 oz. for 1000 plants.
Kale or Sprouts, 1 oz. to 150 feet of drill; 3 to 4 lbs. per acre.
Kohl-rabi, 1 oz. to 3000 plants; 3 to 4 lbs. per acre.
Leek, 1 oz. to 100 ft. of drill.
Lettuce, 1 oz. to 150 ft. of drill, or for 1000 plants.
Martynia, 1 oz. to 100 hills.
Melons (Musk) 1 oz. to about 60 hills; 2 to 3 lbs. to the acre.
" (Water) 1 oz. to 30 hills; 4 to 5 lbs. per acre.
Okra, or Gumbo, 1 oz. to 100 hills; 20 lbs. to the acre.
Onions, 1 oz. to 100 ft. of drill; 4 to 5 lbs. to the acre.
Parsley, 1 oz. to 150 ft. of drill.
Parsnip, 1 oz. to 200 ft. of drill; 5 to 6 lbs. per acre in drills.
Peas, 1 qt. to 100 ft. of drill; 2 bu. to an acre in drills.
Pepper, 1 oz. to 1000 plants.
Potatoes, 8 to 12 bu. cut tubers to the acre, according to method of planting.
Pumpkins, 1 oz. to 30 to 50 hills; 3 to 4 lbs. per acre.
Radishes, 1 oz. to 100 ft. of drill; 8 to 10 lbs. per acre in drills.
Sage, 1 oz. to 100 ft. of drill; 8 to 10 lbs. per acre.
Salsify, 1 oz. to 70 ft. of drill; 8 to 10 lbs. per acre.
Spinach, 1 oz. to 100 ft. of drill; 10 lbs. to the acre in drills.
Squash (Bush) 1 oz. to 50 hills; 5 to 6 lbs. to the acre.
" (Marrow) 1 oz. to 20 hills; 3 to 4 lbs. to the acre.
Tomato, 1 oz. to 1500 plants; ¼ lb. for transplanting to an acre.
Turnip, 1 oz. to 150 ft. of drill; 2 lbs. to the acre in drills.

TABLE IV.—AVERAGE TIME REQUIRED FOR GARDEN SEEDS TO GERMINATE UNDER GOOD CONDITIONS.

KIND OF SEED.	No. days.	KIND OF SEED.	No. days.
Bean	5 to 10	Lettuce	6 to 8
Beet	7 to 10	Onion	7 to 10
Cabbage	5 to 10	Pea	6 to 10
Carrot	12 to 18	Parsnip	10 to 20
Cauliflower	5 to 10	Pepper	9 to 14
Celery	10 to 20	Radish	3 to 6
Corn	5 to 8	Salsify	7 to 12
Cucumber	6 to 10	Tomato	6 to 12
Endive	5 to 10	Turnip	4 to 8

TABLE V.—STANDARDS OF PURITY AND GERMINATION OF AGRICULTURAL SEEDS.

The United States Department of Agriculture has adopted the following standards as the basis for its decisions as to the value of seeds:—

The seeds must be true to name, and practically free from smut, bunt, ergot, insects or their eggs or larvae, and the seeds of dodder (Cuscuta spp.), wild mustard (Brassica spp.), wild flax (Camelina spp.), Russian thistle (*Salsola kali tragus*), Canada thistle (*Carduus arvensis*), cockle, (*Agrostemma githago*), chess (*Bromus secalinus*), quack grass (*Agropyron repens*), penny cress (*Thlaspi arvense*), wild oats (*Avena fatua*), and the bulblets of wild onion (*Allium vineale*). It must not contain more than one per cent of other weed seeds, and should come up to the percentages of purity[1] and germination given in the following table:—

KIND OF SEED.	Purity.	Germination.	KIND OF SEED.	Purity.	Germination.
	*per cent.**	*per cent.*		*per cent.*	*per cent.*
Alfalfa	98	85–90	Melon, water	99	85–90
Asparagus	99	80–85	Millet, common (*Chae-*		
Barley	99	90–95	*tochloat italica*)	98	85–90
Beans	99	90–95	Millet, hog (*Panicum*		
Beet	99	140–150†	*miliaceum*)	99	85–90
Blue grass, Canadian	90	45–50	Millet, pearl	99	85–90
Blue grass, Kentucky	90	45–50	Oats	99	90–95
Brome, awnless	90	75–80	Okra	99	80–85
Buckwheat	99	90–95	Onion	99	80–85
Cabbage	99	90–95	Parsley	99	70–75
Carrot	95	80–85	Parsnip	95	70–75
Cauliflower	99	80–85	Peas	99	90–95
Celery	98	60–65	Pumpkin	99	85–90
Clover, alsike	95	75–80	Radish	99	90–95
Clover, crimson	98	85–90	Rape	99	90–95
Clover, red	98	85–90	Rye	99	90–95
Clover, white	95	75–80	Salsify	98	75–80
Collard	99	90–95	Sorghum	98	85–90
Corn, field	99	90–95	Spinach	99	80–85
Corn, sweet	99	85–90	Squash	99	85–90
Cotton	99	85–90	Timothy	98	85–90
Cowpea	99	85–90	Tomato	98	85–90
Cucumber	99	85–90	Turnip	99	90–95
Eggplant	99	75–80	Tobacco	98	75–80
Fescue, meadow	95	85–90	Vetch, hairy	98	70–75
Lettuce	99	85–90	Vetch, kidney	95	85–90
Kafir corn	98	85–90	Wheat	99	90–95
Melon, musk	99	85–90			

*Impurity allowed refers to inert matter and one per cent (only) of weed seeds other than those practically prohibited, as above noted.

†Each beet fruit, or "ball," is likely to contain from 2 to 7 seeds. One hundred balls should yield 150 sprouts.

[1]This means purity of grain, not purity of stock.

TABLE VI.—QUANTITY OF SEED REQUIRED FOR A GIVEN NUMBER OF HILLS

Corn	1 qt. to 200 hills
Cucumbers	1 oz. to 125 "
Muskmelon	1 oz. to 60 "
Pole beans, Limas	1 qt. to 100 "
Pole beans, Wax	1 qt. to 150 "
Pumpkin	1 oz. to 50 "
Squash	1 oz. to 50 "
Watermelon	1 oz. to 30 "

TABLE VII.—QUANTITY OF SEED REQUIRED FOR A GIVEN LENGTH OF DRILL

Asparagus	1 oz. 50 feet of drill
Beet	1 oz. 50 "
Beans, Dwarf	1 qt. 100 "
Carrot	1 oz. 100 "
Endive	1 oz. 100 "
Okra	1 oz. 40 "
Onion	1 oz. 100 "
Onion sets	1 qt. 50 "
Parsley	1 oz. 125 "
Parsnips	1 oz. 200 "
Peas	1 qt. 75 "
Radishes	1 oz. 100 "
Salsify	1 oz. 70 "
Spinach	1 oz. 100 "
Turnip	1 oz. 150 "

MONTHLY CALENDAR

Under this head some of the principal operations of the year in the more Northern states are referred to, but these can be regarded only as suggestive, since individual conditions as well as the weather vary from year to year. The point should be borne in mind that it is of the utmost importance, and for the greatest profit, to have all garden work done at the proper time; and to do this considerable planning and studying will be necessary in laying out each day's work, as well as the work of the season, so as to make the most of the opportunities offered by weather and season.

January.—The outdoor work is generally quite at a standstill this month, except that manure may be drawn from the stable to the fields needing it, where it may be piled and forked over. Plan out the work of the season, aiming to have the ground and the time of your help occupied all the time. In doing this it is generally best to plan to raise those crops that will not require a large amount of work at the same season, but rather those that will give a succession of work. Market any celery, squash, or other vegetables for which there is a demand.

Send for seed catalogues of leading dealers. Decide what you are going to want. Test the quality of the seeds you have on hand and get your new stock of seed early. Test the seeds received for planting.

February.—The work of this month differs but little from that of January, but, in addition, the following may be mentioned: During the latter part of the month prepare manure for early hotbeds to be started the first of March. Inspect tools, wagons, harness, boxes, and crates for marketing and hotbed sash, and get them into shape for the busy season. In the greenhouse, cabbage and cauliflower plants may be started; and as soon as of transplanting size they should be removed to cold frames, where they should remain until the ground is ready for planting out.

March.—Make up hotbeds and sow in them tomatoes, peppers, cabbage, lettuce, radishes, cress, onions for transplanting, carrots, beets, celery, etc. In the latter part of the month cold frames may be used for the hardy vegetables.

If the ground is fit to work, onion sets may be planted and spinach, hardy peas, and other plants which are generally not sown until April may be sown at this time. Harden off the early cabbage and cauliflower plants.

April.—The hotbeds and cold frames should be in constant use. Plantations of asparagus and rhubarb may be made during this and the following month. Plant onion sets.

Sow hardy (smooth) peas, lettuce, celery, radishes, cabbage, cauliflower, turnips, onions, and spinach, and plant early potatoes as soon as the land is fit to be worked. By the end of the month, wrinkled peas, salsify, and parsnips may be sown. See that tomatoes sown last month are transplanted into beds or boxes so as to have plenty of room. Transplant cabbage plants for the early crop, putting them in deep enough to completely cover the stems.

In the latter part of the month, all the early planted crops may need cultivating and some of them thinning, though but little of this is generally necessary until May. Radishes, lettuce, spinach, and onions from sets and from seed sown in hotbeds in March should be fit to eat or to market.

Haul out manure and plow land for planting next month. Transplant onion plants from the hotbeds to open ground.

May is the month when the larger part of the vegetables are planted.

By the middle of the month it is often safe to plant the more tender vegetables, such as cucumbers, squash, melons, and beans, in the open ground, although nothing is gained by so doing if the ground is cold, when it would be better to wait until ten days later. Corn is frequently planted by the middle of the month, and in early seasons it is a good plan to venture a little of some very early kind during the first week of May. Plant potatoes for general crops.

All the early-planted crops need cultivating frequently, and those in drills need to be thinned.

Plantings for succession may be made of all vegetable seeds and sets put in last month.

Sow cabbage for winter use.

Lettuce, radishes, beets, spinach, asparagus, rhubarb, and bunch onions should now be large enough for use.

Harden off tomato plants and set them out the first part of next month.

June.—Set out tomatoes, celery for early use, peppers, eggplant, late cabbage and cauliflower plants, and sow winter beets.

Plant cucumbers for pickles and beans for main crop. Plant Lima beans the early part of the month. Market the same vegetables as last month, and in addition early peas and, perhaps, early cabbage.

Weeding commences in earnest this month and should begin early, since if neglected it may be cheaper to plow up the whole crop rather than weed it out.

Keep the soil well stirred with the cultivator.

Sow rutabaga turnips.

Stop cutting asparagus by the twentieth of the month. Clean up the bed, manure and plow it.

July.—Plant celery for main and late crop.

Sow string beans, winter radish and rutabaga turnips.

Early potatoes, string beans, cabbage, summer squashes, cucumbers, green corn, onions from sets, and cauliflowers are now of edible size, in addition to those vegetables nearing maturity last month.

Continued cultivation is necessary to protect from drought and to keep plants growing.

August.—Sow string beans and flat early turnips, spinach for spring use, winter radishes, and early peas.

The late crops are now maturing, and we have tomatoes, squashes, the better kinds of sweet corn, and eggplant, onions from early-sown seed, and those transplanted are now dry and marketable. Lima beans will be ready for use the latter part of the month.

Keep weeds from going to seed.

Sow lettuce for growing in hotbeds or cold frames for Thanksgiving.

September.—The cool nights of this month are especially favorable to such crops as celery, cabbage and cauliflower, and they should be carefully cultivated.

Melons, winter squash, and celery are now marketable.

Handle celery; i. e., draw earth up around it.

First frosts may now be expected by the fifteenth of the month, and the half-ripened tomatoes should be picked and allowed to ripen in some shady place. Winter squash should be gathered before it is at all injured by frost.

Dig potatoes.

Transplant lettuce to hotbeds or cold frames. Plant out hardy perennial onions for bunching in the early spring.

October.—Winter celery should be banked up to protect it from severe frosts, and on severe nights it should be covered with straw or hay for protection. It should all be stored away by the end of the month unless plenty of protection is provided in the shape of straw, in which case it is safe to leave it out until the 10th of November. Such crops will not stand with immunity as much frost in the Western states as in the Eastern states. Pull and store cabbage, dig beets, carrots, parsnips, salsify, and potatoes and store in pits or put at once into the cellar. Some parsnips and salsify may be left on high land to be dug in the spring. Plant out rhubarb roots.

Attend to fall plowing and leave in ridges any very heavy land that is needed for early spring use.

November.—In the more Northern states this month generally closes up the work of the season. All the crops should be gathered in the early part of the month.

Clean up the garden, frames, and hotbeds and get them ready for spring work.

The lettuce sown in August and transplanted to hotbeds or cold frames should be fit to market this month.

Market all the vegetables on hand that will bring a fair price, unless wanted for some special purpose or at an assured price.

Cover winter spinach and hardy onion sets with hay as soon as the ground begins to freeze hard at night, to prevent freezing and thawing.

December.—Clean up the garden and continue the marketing of vegetables if it is not already attended to.

Carefully study the season's work, note the profits or losses on the last crop, and what has been learned that will be useful another year.

At odd times the following may be attended to: Gather manure, make crates and boxes for marketing fruits, vegetables, and plants, repair tools, wagons, harnesses, sashes, hotbeds, and cold frames. Clean up!

LABORATORY EXERCISES IN VEGETABLE GARDENING

WHERE the subject of vegetable gardening is given during the spring term of school many interesting laboratory exercises may be conducted in a small greenhouse or garden plot. This adds a great deal to the interest of the students and makes the teaching of the subject much more effective. A very few exercises are suggested below. Many others may be worked out from the text. Where commercial greenhouses or large vegetable farms are to be found in a community, it is well to interest the class in their methods. Visits should be made to these establishments several times during the season and careful notes taken on the work in progress.

1. Make a plan of a kitchen garden, locating vegetables as to position, distance, etc.
2. Use nitrate of soda on one spinach plot and not on another. Use well-rotted and fresh manures on plots.
3. Make and plant hotbeds and cold frames. This is a good problem if manual training is given in the school.
4. Sow seed of various vegetables, to learn names, varieties, and habits.
5. Transplant young seedlings of lettuce, cabbage, celery, etc., to flats and to open ground.
6. Make spraying preparations, and apply them, if possible.
7. Study the value of different tools in cultivating.
8. Use different cultural methods where possible.
9. Compare hand sowing and machine sowing of like seeds.
10. Make germination tests of a number of common seeds.

BOOKS AND BULLETINS ON GARDEN SUBJECTS

Asparagus.—*Bulletins:* Farmers' Bul. 61; California Buls. 165, 172; Maryland Bul. 151; Ottawa Pamphlet 5.

Books: Asparagus, F. M. Hexamer, 50 cents; Asparagus Culture, James Barnes and William Robinson, 50 cents.

Beans and Peas.—*Bulletins:* Cornell Buls. 239, 260; Louisiana Bul. 119; Michigan Bul. 259; Farmers' Bul. 121; Delaware Bul. 41.

Books: Bean Culture, Glen C. Sevey, 50 cents.

Cabbage.—*Books:* Cabbage, How to Grow, James J. H. Gregory, 30 cents; Cabbage and Cauliflower for Profit, J. M. Lupton, 30 cents; Cabbage, Cauliflower and Allied Vegetables, C. L. Allen.

Celery.—*Bulletins:* Farmers' Buls. 148, 282; Colorado Bul. 144; California Bul. 208; Ohio Circular 72.

Books: Celery Culture, W. R. Beattie, 50 cents; Celery Culture for Profit, T. Greiner, 20 cents; Culture of Kalamazoo Celery, G. Von Bochove, 50 cents.

Cucumber.—*Bulletins:* Dept. of Agriculture, Harrisburg, Pa. No. 96; Farmers' Buls. 231, 254.

Books: Cucumber Culture for Amateurs, W. J. May, 50 cents.

Melons.—*Bulletins:* Bul. 104, Colorado, Rust Resisting Cantaloupe; Bul. 108, Colorado Cantaloupe Culture; New Mexica Bul. 63, Melon Culture; Purdue Bul. 135, Vol. 14, Gems; Illinois Bul. 125, Muskmelon Marketing; Illinois Bul. 155, Muskmelon Fertilizers; Colorado Bul. 85, Cantaloupe Seed.

New Hampshire Bul. 86, Watermelon; South Dakota Bul. 67, Melons; Georgia Bul. 38, Watermelons.

Books: Melon Culture, W. W. Tracy, 50 cents; Melon Culture, Troop, 50 cents.

Mushrooms.—*Books:* Mushrooms, George E. Atkinson, $3.25; The Mushroom Book, Nina Marshall, $3.25; Mushrooms, How to Grow Them, William Falconer, $1.00.

Onion.—*Bulletins:* Farmers' Buls. 39, 354, 434; New Mexico Bul. 82; Texas Bul. 77; Idaho Bul. 22; Colorado Bul. 81; Indiana Circular 15.

Books: New Onion Culture, T. Greiner, 50 cents.

Potato.—*Bulletin:* Minnesota Extension Bul. 38.

Books: The Potato, Samuel Fraser, 75 cents; The Potato, Grubb & Guilford, $2.00.

Rhubarb.—*Book:* The New Rhubard Culture, J. E. Morse, 50 cents.

Squash.—*Book:* Squashes, James J. Gregory, 30 cents; Rhode Island Bul. 41.

Sweet Potato.—*Book:* Sweet Potato Culture, James Fitz, 50 cents.

Tomatoes.—*Bulletins:* Farmers' Bul. 521; Pamphlet 10, Ottawa, Canada; Florida Buls. 91, 112; Virginia Bul. 192; Mass. Hatch Sta. Bul. 105; Ohio Bul. 153; Illinois Buls. 81, 144; Virginia Bul. 177; Texas Bul. 65.

Books: Tomato Culture, W. W. Tracy, 50 cents; Tomato Culture for Amateurs, B. C. Ravenscroft, 50 cents; Tomato Culture, Day, Cummins and Root, 40 cents.

General Books.—Vegetable Gardening, R. L. Watts, $1.75; The Forcing Book, L. H. Bailey, $1.35; Garden Making, Hunn & Bailey, $1.50; The Principles of Vegetable Gardening, Bailey, $1.50; Garden Farming, L. C. Corbett, $2.00.

General Bulletins.—Farmers' Bul. 460, Frames as a Factor in Truck Farming; Farmers' Bul. 255, Home Vegetable Garden; Illinois Circular 154, Home Vegetable Garden.

Publications.—The Market Growers' Journal; The Garden Magazine, New York City; The Vegetable Grower; Seed Catalogues.

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