UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE
BERKELEY, CALIFORNIA

AGRICULTURAL EXPERIMENT STATION
E. J. WICKSON, DIRECTOR

CIRCULAR 46

Suggestions for Garden Work in California Schools

By Ernest B. Babcock

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(OCTOBER, 1909)

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CONTENTS.

School gardens teach, among other things, private care for public property, economy, honesty, application, concentration, justice, the dignity of labor, and love for the beauties of nature.—JAMES RALPH JEWEL.

SUGGESTIONS FOR GARDEN WORK IN CALIFORNIA SCHOOLS

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INTRODUCTION.

To the teachers in California public schools no apology should be needed for introducing the subject of gardening. *The school garden has come to stay.* It is not a fad. On the contrary, it is "a fundamental prerequisite to all true nature-study," and the value and place of true nature-study is now firmly established. The term nature-study is more or less familiar to all, but the conception of the meaning of real nature-study is not so general. However, the works of Hodge, Jackman, Bailey, Holtz, and others and the "Nature-Study Review," the official organ of the Nature-Study Association, together with the efforts of educational institutions from the national bureau down to the individual normal schools, are all helping to infuse the new ideal into the minds of American teachers. Nature-study is many sided. The physical, the biological, the agricultural phases all have their valuable features, but authorities are quite generally agreed that, if any one phase deserves prominence, that phase is the agricultural especially when introduced through garden work.

As the result of local efforts, made from time to time throughout the State, many successful children's gardens are flourishing today. But these are as yet confined too largely to the cities and towns. The patrons and teachers of rural schools seem less willing to take up this new line of work. There are many reasons for this attitude and one may not criticize without due regard for these reasons. On the other hand the schools of many of our most progressive cities and towns are as yet unprovided with proper facilities for garden work. These conditions

exist although it is largely a matter of realizing the great desirability of this phase of school life and then having the will to secure it. We wish that every teacher in California might read the report on School Gardens written for the National Bureau of Education by James Ralph Jewell.[1] In concluding Mr. Jewell writes as follows:

"Are there too many obstacles in the way of establishing and maintaining a garden in connection with the average school, urban or rural, to prevent its being a success? I believe not. I do not know in what other undertaking there are so many demonstrations that where there is a will there is a way. There is no record of a failure in any city slums except for want of funds, although, so far as I know, every neighborhood has been, if not hostile at the first, at least incredulous of the possibility of success. It would perhaps be hard to name a difficulty which has not been overcome or circumvented in some way by the enthusiasm of the children and the careful planning of a competent teacher.

"Nor is this educational agency confined to city schools. In Europe the school garden is held to be especially an adjunct of the rural school; in Canada the consolidated rural schools have the best gardens. True, there cannot be a very elaborate garden at a school of only ten or a dozen children; but Superintendent Kern (of Winnebago County, Illinois) and others have taught the teachers under them to make the most possible of gardens in very small rural schools, with no aid except that so readily given by the children.[2] It is strange that other countries think gardens especially fitted for rural schools, while we think them better for city schools. Probably it is because we are apt to fold our hands complacently and say that the children of our rural communities learn practical agriculture at home. Well and good, but do they learn the best? Would not the school garden in the country teach even more than the children pick up from what they see done at home? How many a farm boy, who will practice farming all his life, goes through his school life in the school and at home without knowing how the roots of corn spread out, or how to cultivate the corn properly to insure the largest yield, except as he follows what he sees others do and without knowing a hundred things of the kind which science is waiting for him to learn and utilize? How many country boys have been given

[1] For references by number see pages 43 and 44.

[2] See "Among Country Schools," by O. J. Kern, Ginn & Co., Boston.

anything to think of as they hoe potatoes except that their city cousins are not blistering their hands so?

"Of what value are school gardens? What can they be depended upon to do? Certainly, what they have done, at least. They have given whole schools a new incentive, and have raised the daily attendance materially; they have proved an open sesame into both the problems and interests of life to children always before considered dull; in cities where some children had school gardens and some had not, the former are reported to have made much greater development in a given time than the latter; after certain schools had allowed their children to devote as much as two hours a day to their gardens the pupils accomplished more with their regular studies during the rest of the day than they had done before in all the time. Country children have become interested in the science of their future life occupation, and so have been taught to think for themselves and to respect their calling. Children have been taught through these gardens more about practical ethics than by any other means yet devised, besides learning something of the fundamental occupation of mankind—tilling the earth."

These words, from the pen of an authority who has examined the history of school gardens from their origin and investigated their status in all countries, are words not to be lightly set aside or forgotten. Therefore, it is with the hope that more people may be interested and more teachers encouraged in beginning garden work in the public schools that this circular is issued.

PURPOSE OF THIS CIRCULAR.

1. To interest California educators in the subject of school gardens;

(*a*) By telling and illustrating some things that have been done.

(*b*) Through suggesting what may be accomplished by our school children under proper leadership.

2. To give brief directions and suggestions for the use of those who have no other guide at hand and a list of references to easily available literature.

3. To state briefly what opportunities there are in California to obtain special preparation for teaching elementary agriculture including school gardening.

Fig. 2.—Lawn and border grown by the pupils of the Washington school, Berkeley, 1908.

The Garden Movement.

School garden beginnings in America formed only a part of a greater garden movement, which had its origin some fifteen years ago. Certain practical philanthropists in our large cities saw the need of providing work for the unemployed. As a result of their early efforts we now have such institutions as the Philadelphia Vacant Lots Cultivation Association, which helps hundreds of poor families to better their own circumstances, and the Cleveland Home Gardening Association, which annually sells over 700,000 packets of flower and vegetable seed to school children at the price of one cent per packet.

The pioneer in school gardens in America is Mrs. Henry (Fannie G.) Parsons, Director of The First Children's School Farm in New York City and President of the International Children's School Farm League (4). If every teacher in California were willing to overcome difficulties only a fraction as great as those surmounted by Mrs. Parsons in her determination to see "children in their natural environment, in close touch with nature and allowed an opportunity to develop their own individuality," there would be less need for exhortation.

The early and successful efforts of certain schools and institutions have had their share of influence. Such are Hemenway's Junior Horticulturist's School at Hartford, Conn., the Fairview gardens for poor children at Yonkers, N. Y., the Whittier garden at the Hampton Institute, Hampton, Va., and the County schools of Winnebago Co., Illinois. But it was not until the United States Department of Agriculture and certain of the state experiment stations became actively interested in elementary education in agriculture that the full importance and unlimited possibilities of school gardens came to be realized in this country. The ultimate aim of these institutions is the elevation of the agricultural community, which means, generally speaking, one-third of the American people. They aim to make the farmer more efficient and so to increase his annual income. That public school teachers may aid in bringing about such a far-reaching result as this, may be a new idea to some who read this circular, but it is quite true. Look, for example, at what the MacDonald School Gardens have done for the province of Ontario, Canada. Professor B. M. Davis says: "The Canadian children undertook to improve the seed of wheat and oats and in three years the

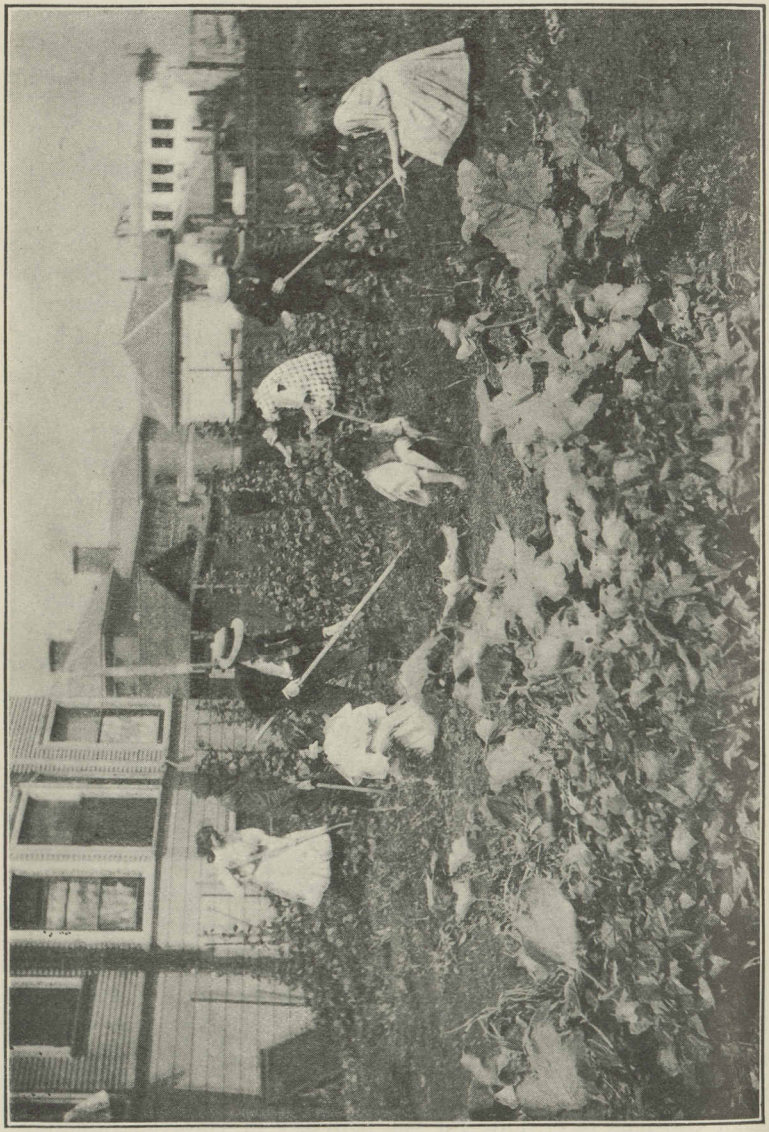

Fig. 3.—Vegetable garden of the Washington school, Berkeley (on a vacant lot), 1908.

gain (in production) was 27 per cent. for wheat and 28 per cent. for oats. It is not exaggeration to say the children forced their fathers to begin systematic effort to improve their seed."

The lively interest of federal and state authorities in this phase of agricultural education is evidenced by recent publications (5) (6) (7). The general consensus of opinion of these and other writers is that some sort of a beginning in agricultural instruction should be made in every rural school. The use of a text in grammar grades as compelled by law in certain states may be the surest way to begin. But the introduction of good garden work in connection with nature-study in the primary grades as a foundation and the emphasis of home and school experimental gardening for the older pupils along with their school room study of agriculture has been found to give infinitely richer results.

What Teachers Have Done.

Some California teachers, who conduct garden work in their schools, have replied to inquiries made by this experiment station and all, from whom reports have been received, speak favorably of the value of the school garden. Portions of a letter from Miss Zilda M. Rogers, a teacher in Ventura, are given below and figure 4 illustrates the garden described.

"Our garden work is yet very young. This is really the first year it has been carried on systematically at all. Our grounds are very small, far too small, for so many children, but small as they are the work has paid tenfold for every hour spent upon it. Last fall we raised a crop of vegetables and have replanted as the vegetables have been removed since. Our fall crop was only fair. This spring the vegetables are choice. I have allowed the children to plant whatever they wished providing the plants were not too large for the space allowed. Some of the pupils have harvested six or seven crops of radishes and lettuce this school year. Around the border of the garden we have vines planted. In another year there will be no ugly fence showing.

"With the exception of a boy and a girl the children will gladly leave their play to work in 'our garden.' Some of them devote every recess to their gardens, not always working but watching others plant seed or just admiring their plants. With the love of the school garden has grown the desire for a home garden and some of their plots at home are very good. Each

one would like to have his garden the best in town. Since commencing the garden work the children have become better companions and friends. They have learned to respect other people's property and to feel that there is a right way of doing everything. The children and I have become closer friends than we ever could have in any other work. It is *our* garden. We try to carry that spirit into our schoolroom.

Fig. 4.—A Ventura school garden, 1907.

"From this year's experience I should say a school loses a golden opportunity to help the child when it does not make an effort to have a school garden."

It would be interesting to hear from every teacher in the state who has introduced gardening into the school and to know of the difficulties, failures and successes. However, the expressions in the letter just quoted should be sufficient to convince the most skeptical that a school garden is worth having.

We have attempted to show by means of illustrations what has been accomplished in a few California schools. In figure 7 is shown the garden at the Clearwater school (Los Angeles

County) in 1907, Mr. Clarence Dickison, principal. Figures 8 and 10 show two views of the gardens of the Redlands school children under the supervision of Mr. C. T. Wright. Figure 3 shows the vegetable garden of the Washington school, Berkeley, Mr. John A. Imrie, principal. This is located on a vacant lot near the school where water is obtained free. Figure 2 shows the success achieved by the pupils of the same school in beautifying the grounds. The clover lawn and the mixed border of sunflowers, cosmos, marigolds and pansies were all grown by the older pupils. The photograph shows a second grade nature-study class enjoying an outdoor lesson. Strenuous efforts on the part of the boys were necessary in beginning this improvement. The soil had to be loosened with picks first, then soaked and forked over and finally leveled for seeding.

In figure 5 are shown the gardens of the third, fourth, and fifth grades of the West Vernon Avenue school, Los Angeles City, Miss Josephine Bont, principal. Miss Bont writes as follows: "The pupils did all of the preparatory work for their gardens, clearing a weed-covered lot, laying out the gardens, and digging them. They were successful and the children and parents were delighted with the results. Since we began our school gardens in these grades I find the other children anxious to have them."

The garden work of the Los Angeles Normal School is illustrated in figures 1, 9, 11, 12, 13, 14, the photographs being furnished by Mr. Clayton F. Palmer, Instructor in Agricultural Nature-Study in that institution. The gardens conducted at the San Diego Normal School in 1907 are shown in figure 6. It was hoped that the other normal schools might be represented in this way, especially the school at Chico, where Mr. C. A. Stebbins has developed the garden work on original lines. Mr. Stebbins has published some excellent discussions and directions for the use of the student teachers. But very little of this material is available for general distribution as yet. Perhaps the most novel phase of garden work introduced into the Chico normal training school is the "school bank." As latest reports indicate that this device has proved to be of great value, we give below Mr. Stebbin's original plan as published in a pamphlet, of which the first edition is exhausted.

"A school garden, if well planned, carries the life of the community. Any business, as it develops and becomes more complex, calls for new methods, so the increasing business side of the

Fig. 5.—Gardens of the 3rd, 4th, and 5th grades at the West Vernon Avenue School, Los Angeles, 1907.

gardens and the demand for more practicability in school work are calling for a school bank. Any available space, convenient to the pupils, should be fitted off with desks, railings, etc., to make the surroundings banklike. The officers of the bank should be the regular officers chosen from the school body, with a teacher as general supervisor.

"The policy of the bank should be to lease the individual gardens for a nominal sum, to sell seeds, to furnish tools at a low rental, to loan money to be expended in school work, to pay interest on deposits, to buy seed grown by the pupils, to purchase plants from the children, etc. Not only should the business life of the gardens be fastened to the bank, but it should carry the practical side of the other school subjects, particularly that of arithmetic. To know the vital part of a principle, we should be a part of its expression and feel the reaction. To understand interest fully, we must borrow or loan money or be connected in some way with interest at work. The bank should make each pupil an acting part of each business transaction, indicated by the study of arithmetic. The acceptance, endorsement, presentation, and receipt of money, processes connected with one check, would short cut the way through the days of artificial processes now in use and never applied.

"The business life of a community centers about the public source of money. Thus the school bank should inoculate the children with the principles that would direct their future conduct. With the gardens to furnish the money, with the bank to use it, and with arithmetic to direct the several processes, we would have a miniature community life."

Mr. Stebbins reports that a year's trial of the school bank has clearly demonstrated its great value. The bank leased the gardens to the children. The children marketed their produce and paid their rent. About one hundred and fifty dollars has been handled by the bank during the past year.

What Teachers Can Do.

General.

Any teacher, who is willing to try, can make a beginning in school gardening. A little reading of the publications to be obtained free or at nominal cost, a little careful planning and judicious leading of the children, and almost any difficulties can

be overcome. In schools of more than one teacher it will be necessary to have the consent and co-operation of your principal in order to secure location, water, and tools. As regards the two latter requisites, you will be surprised to find how well the children can help you out of difficulties when called upon. The boys and girls in the first school garden in New York City had nothing but clam shells with which to dig but the fame of that garden

Fig. 6.—Gardens at the San Diego State Normal School in 1907.

has spread throughout the world. The use of watering pots or even pails or cans with which the soil can be soaked is to be recommended above sprinkling with a hose (although the seed bed must be sprinkled to keep shallow planted seeds from drying out). Such watering can then be followed by proper surface tillage and the loss of water by evaporation reduced to a minimum. This is a fundamental principle in California agriculture. It may even be necessary for some schools to practice "dry farming" (10). But, in demonstrating the practicability of this system of agriculture, you may render an inestimable service to

the community. Do not strive for artistic effects in the garden itself. Evidence of intelligent care and of orderliness is of most importance.

A school site on top of a rocky hill with no well may seem a rather forbidding prospect for school garden work. But even here much may be accomplished in improvement of grounds by planting varieties of Eucalyptus (11), Bottle-brush and Cypress, the Nut Pine (*Pinus monophylla*) and other native trees, shrubs and perennial herbs. Secure seeds from your own vicinity with the pupils' help, from any California seedsman (12a), or from the experiment station at Berkeley. Distribute seed among the pupils giving directions for propagation and a year later make a special effort to get the strongest specimens established on the school site during the rainy season. If funds are available, one-year-old plants can be purchased and set out the same year (12). The less opportunity there is for gardening at the school, the more stress should be laid upon competitive and experimental home gardening. Holding an annual exhibition and giving prizes will furnish an incentive to earnest effort.

Experimental work of a very definite nature and with a fair chance of securing distinct results has proved the most successful of any garden work for grammar grade and high school pupils in other states. In various parts of the corn belt of the middle west the boys' experimental clubs have been carrying on work in corn improvement for several years and many striking and profitable results have been secured. To quote from a committee report to the National Council of Education, July, 1905 (13):

"It is in such ways as these that the enterprising county superintendent may stand as a middle-man between the experiment station and the children on the farm. In Cook County (Chicago) one of the assistant county superintendents, Charles W. Farr, during the month of April, 1905, held a series of "corn meetings," the announced purpose of which was to consider with the schools of an entire township, and the parents of the children: (1) The growth and fertilization of corn, emphasizing the possibility of breeding it with the same degree of care with which animals are bred; (2) to study thoroughbred ears of corn furnished for the purpose by professional corn breeders; (3) to consider samples of corn furnished by local farmers with reference to the selection of seed; (4) to encourage the boys to send for seed corn and enter the annual contest; and (5) by means

of samples to set forth clearly the printed matter offered to the farmers by the experiment station. These meetings were well attended by old and young, and the most enthusiastic interest was awakened.

"All this means more and better corn, of course. But it means much more. *The attitude toward farm labor—all labor—is changed.* The combination of intelligence with manual labor arouses a quality of interest which gives farming as an occupation, an even chance with other occupations to appeal to boyish imagination at the time when he is beginning to think about his life work. Superintendent Farr is the author of a formula which tells the whole story: *'Seed + Soil + Moisture + Heat + Boy = Corn.'*

"The plan of organization and work of boys' experiment clubs and girls' home-culture clubs in Illinois, as described, has been adopted in a few localities in Ohio, Wisconsin, and Texas and possibly in other states.

"The systematic study of the cultivation, breeding and judging of corn carried on by the boys in Illinois, through definitely organized effort, has made available for them and their fathers the results of the scientific investigation of this cereal, carried on by experts in the agricultural college of the state, and will add hundreds of thousands of dollars to the value of the yearly corn crop in Illinois.

"All such work properly directed and organized is a move in the direction of awakening new interest and a practical intelligence in the affairs of the home and the farm. It reaches the parents and affects them in useful ways. Out of these experiments and activities will come an organized body of knowledge in form available for the teacher and for use in the schools of the country.

"Such clubs may be organized in every state in the Union for specific work on the particular products of the locality, provided there are men and women in these states who will make a study of local needs and inaugurate lines of effort, which will appeal to the interests of the community under definite practical plans of organization."

When we consider the unlimited possibilities, which are afforded for the sort of work described above by the varied soils, climatic conditions and products of our great state, it is difficult to conceive how any educator, whose privilege it may be to cham-

pion this cause, can fail to make an earnest effort to establish the home experimental work among the school children of California. In order that the greatest good may result to the community at large, it is necessary that there be some central directing agency. The college of agriculture and state experiment station, from which this circular is issued, is prepared to assume this office. The division of agricultural education will co-operate with any one interested in the promotion of agricultural teaching in the schools. It is our aim to assist directors, superintendents and teachers in maintaining agricultural instruction. Certainly one of the most effective methods of introducing it, is by means of boys' and girls' clubs (15a).

One phase of club work in which pupils in town and city schools should be as much interested as those who live in the country is the tree growing movement. This worthy cause is represented by the Federation of Tree Growing Clubs of America, H. A. Greene, President, Monterey, California. Their circular of information (19) is full of helpful suggestions for any one who wishes to undertake the organization of such work. Moreover, "the federation will furnish tree seeds free of cost, except postage, ..., to all good people willing to assist in the great tree growing movement."

Small Rural and Special Ungraded Schools.

In smaller rural schools, for the first year or two at least, the garden may be planned mostly for the children in grammar grades—not to exclude the younger ones in case it is practical to accommodate them at the outset—but to emphasize the garden as a place in which the older children can carry on experimental work adapted to local climatic and soil conditions. Start the garden as an outdoor laboratory, choosing some particular lines of study which will appeal to both children and patrons. A logical, progressive working-plan, which may be taken up by a new teacher where his predecessor left off, might be somewhat as follows:

First year.—Lay out individual plots as large as possible for each pupil who wishes to have a garden and provide two community plots in which all shall have a share. Center the work in individual plots on *plant propagation* encouraging the pupils to experiment with as many different methods as possible. But

plan the work sufficiently so as to be sure each pupil becomes familiar with propagation by seed, bulblets or sets, and cuttings or slips. Familiarity with the first method will be assured if care is taken to plant along one edge of a community plot a row of peach, plum, apricot, almond, walnut, apple, pear, or quince seeds, which should produce seedling trees that may be used a year later for exceedingly interesting lessons in budding and grafting. For propagation by bulblets, onion sets may be used

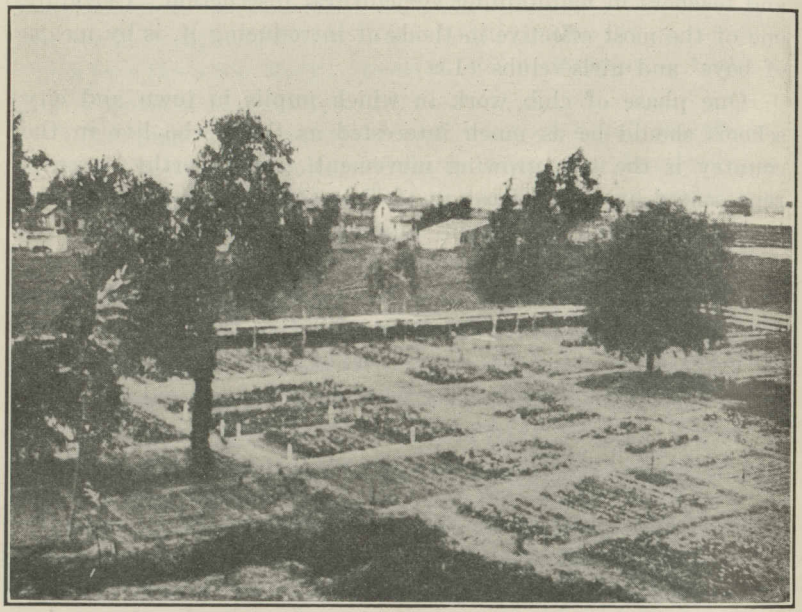

Fig. 7.—Gardens at the Clearwater school, Los Angeles County in 1907.

or young freesia or gladiolus bulbs, or better still these sets may be grown from seed the first year and then used by each pupil in his home garden the following year. In the same way plants propagated from cuttings like the rose, geranium, fuchsia, coleus, carnation and a host of others may be used for ornamenting the school or home grounds. If the boys are more interested in crop plants let them root cuttings of grape, raspberry or blackberry, heeling them in the fall in a shady place and setting out the next spring. Of Irish potato make cuttings of the tubers leaving about two eyes in each piece. In locations having warm sandy

soil sweet potatoes may be propagated by covering with sand and keeping moist until sprouts appear, then removing the sprouts and setting out. Here also peanuts are easily grown from seed. In places where citrus fruits or the olive are grown, an interesting experiment will be to try cuttings of the various varieties and compare the root systems produced with those of seedlings of the same variety. These are only a few suggestions of the many things that may be done in connection with plant propagation.

In one community plot make experiments with commercial fertilizers on various crop plants grown in the vicinity. Leave small check plots that can be watered separately and give these no fertilizer whatever. Use varying amounts on the others and have pupils keep records of experiments and results. In the other community plot begin a collection of native plants. Too often the children pass them by without appreciating them. If your school is situated particularly unfavorably for the purpose of securing many interesting plants, make excursions for them, correspond and exchange with other teachers or with parties who have native seeds and bulbs for sale (12a). A little effort will bring many acquisitions and much valuable nature-study material will be secured which is of the greatest interest to all because it is of our native flora. In any part of this plan that may be attempted during the first year the underlying principles of plant production, as set forth in your elementary text on agriculture, should be emphasized, and the pupils directed to put into practice the knowledge derived from the text.

Second year.—Center the work in individual plots on *experimental plant improvement* (15b). Let the boys choose some common farm crop or vegetable that is grown at their homes. If possible, have them select their seed from plants on the farm, giving attention to size, fruitfulness, health, and hardiness. Emphasize the necessity of making conditions in the individual plots as favorable as possible to the highest degree of vigor in the particular plant to be raised. This will necessitate careful observation and thought on the part of each pupil. The use of fertilizers may be tried. As the crop develops, have them make a study of each individual plant, marking those that seem likely to be of value and discarding those that are of low value for any reason. Keep the strongest plants and eventually save the seed only from the *one* or *two* very best plants. This seed

can be planted, all or in part, at home the following year, and the process of selection repeated. The girls, in their individual plots, may carry on the same kind of work with either vegetables or flowers. If possible, encourage them to experiment with some native flower the seed of which can be obtained in your vicinity. With this work in mind for the coming year, the pupils can be led to collect seed during the present year, following the same care in selection as the boys practice among the farm crops. The principles of intensive cultivation and selection will be the same.

In the community plots add to the native plant collection and change the former fertilizer plot into a model kitchen garden, introducing varieties of vegetables new or little known in the district.

Third year.—Individual plots. Continue the work of plant improvement, or, if this has been transferred entirely to the homes, turn the plots over to younger pupils.

Community plots as before, or have a model flower garden in one of them.

Some teachers may find themselves at a loss to know what crop plants to recommend to the pupils for their experimental plant improvement work. In this connection we give the following classified list of economic plants, most of which were suggested by reviewing the manuscript of a new text in elementary agriculture by Professors Hilgard and Osterhout of the University of California. This work is now in an advanced stage of preparation, and the teachers, besides being ready to use this help when it does appear, may well plan to make their garden work correlative and supplementary to it. Therefore, the list is given primarily for this reason, but teachers who desire a guide in selecting varieties for model or demonstration plots will also find suggestions in this classification. For example, a collection of the varieties of the "cabbage group" of vegetables would excite interest and impart useful knowledge.

List of Crop Plants Suitable for Experimental Plant Improvement and School Garden Work.

I. Field Crops.

1. *Cereals.* Named varieties, such as those mentioned in Hilgard and Osterhout and California station bulletin No. 185.

2. *Non-saccharine Sorghums.* Broom-corn, kafir (kafir "corn"), and durra (Egyptian and Jerusalem "corn" and milo "maize").

3. *Sweet Sorghum.* Suitable for northwestern California.

4. *Beans and Peas.* Lima bean, white navy bean, frijoles, broad beans, cowpeas, peanuts, garden peas.

5. *Grasses.* For schools in the region of cattle ranges, a collection of the grasses described in Hilgard and Osterhout.

6. *Cover Crops or Green Manures.* Hairy vetch, Canadian field pea, lupins including native varieties, Oregon winter vetch.

7. *Root crops.* Sugar-beet, field beets, turnips, carrots, Irish potato, sweet potato.

8. *Miscellaneous crops.*

(*a*) *Fiber plants.* Cotton, flax, hemp, agave, mulberry tree.

(*b*) *Honey plants.* Native and introduced.

(*c*) Asparagus, celery, hops, rhubarb, and other crops grown in certain districts of the State.

II. Vegetables.

1. *Roots and Bulbs.* Carrot, parsnip, salsify, onion, chive, leek, garlic, celeriac.

2. *Leaf Vegetables.* Varieties of lettuce, spinach, chard, corn salad, Chinese mustard, the "cabbage group", including cauliflower, broccoli, brussels sprouts, kohlrabi, collards, kale or borecole.

3. *Stem Vegetables.* Celery and asparagus, both good for experimental work in control of plant diseases.

4. *Fruit Vegetables* (not sweet). (*a*) tomato, eggplant, peppers large and small; (*b*) cucumbers, pumpkins, squashes.

III. Sweet Garden Fruits.

1. "Small Fruits." Strawberry, raspberry, blackberry, loganberry, gooseberry, currant.

2. Watermelon, muskmelon, including the "casaba" or winter melon.

3. Grapes. (*a*) For schoolyard arbor; (*b*) for practice in grafting on resistant roots [see circular No. 26 and bulletins No. 180 and 197 of this experiment station]; (*c*) for propagation from seed as a phase of plant improvement.

Large Rural, Town, and City Schools.

Gardening should be planned as a part of nature-study, so as to supplement its other phases, and to accompany the study of botany and horticulture in high schools. It may be correlated with oral and written expression, manual training, geography, history, arithmetic, and bookkeeping (2). In smaller graded schools having two or three grades in a room, it is advisable to arrange the nature-study in groups of grades somewhat as follows: Group I, grades 1 and 2; Group II, grades 3 to 5; Group

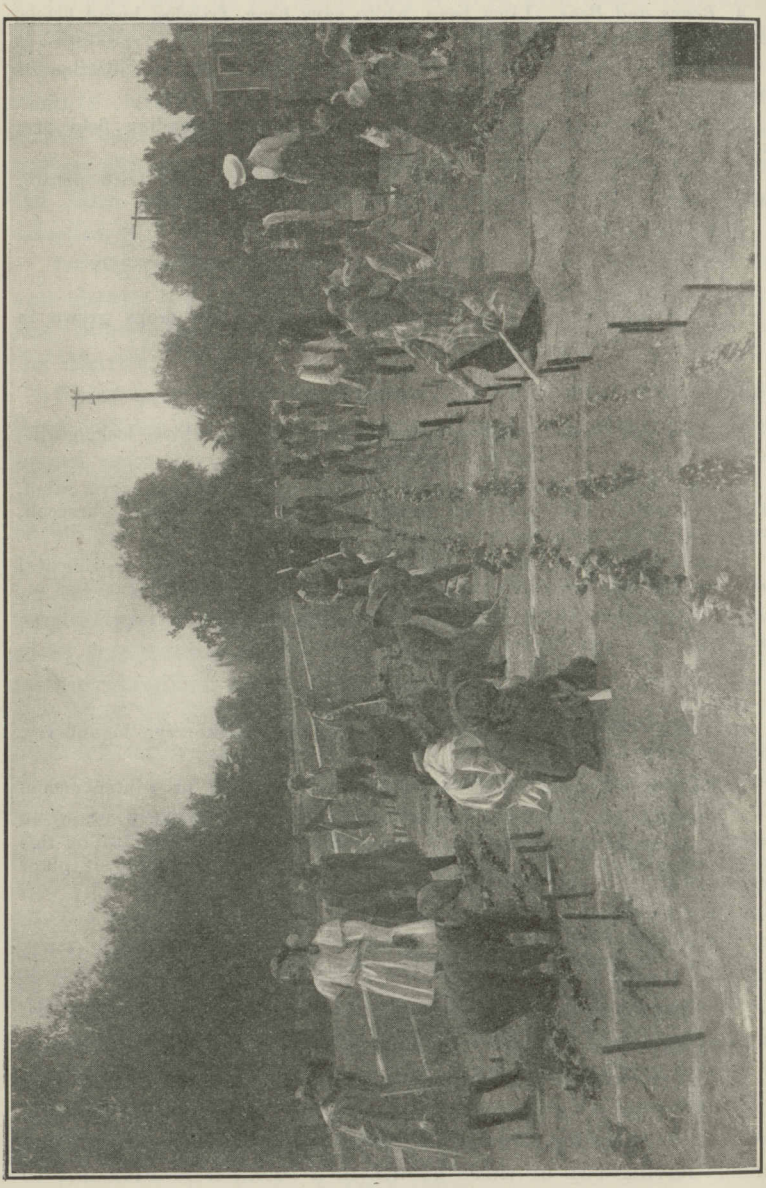

Fig. 8.—Pupils of a Redlands school working in their gardens, 1907.

III, grades 6 to 8. Here the work of each group may be progressive from year to year, beginning with that suggested below for the lowest grade in the group and proceeding to that of the highest. The following general outline, adapted from Crosby's report, will suggest the possible coördination between the garden phase and the other phases of nature-study. For details and further references consult Wood (8), Crosby (6), and Miller & Babcock (9), as well as your course of study and standard works on nature-study and elementary agriculture.

Outline of Nature-Study by Groups.

Group I, Grades 1 and 2.

Character of Instruction.

Observation, identification, oral description; for general knowledge of immediate environment: the weather (18), wild and cultivated plants and trees, insects, earthworm, wild and domestic animals, common birds and reptiles; seeds, how they sprout; seed distribution; plants, how the grow; bulbs grown in water.

Garden Phase.

School garden, individual plots. Plant and grow common, hardy, large-seeded vegetables, such as radishes, dwarf peas, beets, onions from sets, and one or two quick-growing flowers, such as dwarf nasturtiums, dwarf morning glory, four-o'clocks. Demonstration lessons in planting and cultivating given by teacher.

Group II, Grades 3 to 5.

Character of Instruction.

Observation and comparison, practice in identification, oral and written description. Add to general knowledge and specialize in correlation with home geography. Observe wild and cultivated plants and trees, "dry-weather" plants, pond plants, economic plants and their uses; mammals, birds, fish, the mosquito and other economic insects; physical nature-study (18). Begin organization of school or class "Nature-study clubs", in the fifth grade making a "club meeting" of the nature-study period. Have reports on the experiments in plant propagation in home and school gardens, and any other nature-study topics.

Garden Phase.

School garden, individual plots, and home garden.

(*a*) Plant and grow vegetables and flowers requiring more skill than those recommended for Group I. (*b*) Plant and grow typical crop plants of the region, giving some attention to varieties, harvesting, and methods of handling raw materials. (*c*) Begin experimental study of plant propagation in the fifth grade [see outline for small schools]. (*d*) Encourage the collection of native plants and shrubs for the school garden (community plot) or home gardens. This phase deserves more attention. Do not hesitate because you do not know botanical names. Get acquainted with the plants and use common names.

GROUP III, GRADES 6 TO 8.

Character of Instruction.

Observation, comparison, judgment. Study objects, as above, within and beyond horizon of children's observation; introduce bulletins, text-books, and reference-books as sources of information, particularly as follows:

For the sixth grade, U. S. D. A. bulletins and circulars on plant propagation, plant improvement, and forestry (20).

For the seventh grade, texts and bulletins on agriculture and horticulture (20).

For the eighth grade, texts, bulletins, and laboratory work on human physiology, hygiene and foods.

Emphasize outdoor and indoor experimental work in sixth and seventh grades (16).

The comparative study of root systems of crop plants may be made a valuable indoor adjunct of the outdoor work in these grades.

NOTE.—It will be recognized that the work suggested for grammar grades is not all observational study. But it is intended that nature-study ideals shall obtain and that the nature-study method shall be used as far as practicable. The value of *experimental work*, doing, seeing, and inferring by the pupils themselves, cannot be overemphasized, providing the course of experiments is well planned and consistently carried out.

Garden Phase.

School and home gardens.

Sixth Grade: (*a*) Continue study of plant propagation, both in individual plots and the community nursery, where seedlings and cuttings for budding and grafting should have been started the previous year. (*b*) Encourage pupils to experiment at home and to make observations and reports in connection with their indoor study or club meetings. Conduct excursions. (*c*) Reserve "problem plots" for the purpose of settling disputed questions or giving demonstrations. Or (*d*) crop improvement through seed selection may be the chief line of study for the year with plant propagation and forestry subordinate.

Seventh Grade: (*a*) Application of indoor experimental study in soils and plant growth to problems in irrigation, cultivation, fertilizing, crop rotation, seed and soil inoculation. (*b*) Continue or begin work in crop improvement or amelioration of some wild plant. [See outline for small schools.] (*c*) Encourage pupils to grow crops and domestic animals at home, keeping account of labor, fertilizers, feed, gross and net returns.

Eighth Grade: Experimental work of Seventh Grade continued. If the study of crop or plant improvement has been successfully introduced, pupils of this grade will wish to continue their experiments at home.

The question of what, when, and how to plant are, of course, matters of paramount importance to the individual teacher. It is scarcely within the scope of this circular to furnish such detailed information in quantity sufficient to meet the need of every locality in California. The necessary directions for growing any particular crop can usually be obtained from the dealer or grower who furnishes the seeds or plants. Reference works such as encyclopedias of horticulture and books on gardening will be useful for this purpose. The experience of farmers and gardeners of the vicinity will usually be of value. If special

need should arise, letters of inquiry may be addressed to the members of the experiment station staff. Some definite suggestions will be found in the discussion of work for small schools and the instructions for teachers. In addition to these, the following planting guide, which is adapted from the "Plant Calendar" in Davis' Manual (2) should be of some assistance. It is intended to serve as a general guide and not especially for any one locality. The hyphen is equivalent to "to."

Fig. 9.—Nora de Generes, age 11, and her six-pound beet, May, 1908.

Plants that Thrive with Comparatively Large Amounts of Water.

VEGETABLES.

Name.	*Time to plant.*	*How long to grow.*
Artichoke	Seeds, Jan.-Feb. (in boxes)	1 year
"	—Roots, Nov.-Mar.	1 year
Asparagus	Seeds, Feb.-Mar. (in beds)	2-3 years
"	—Roots, March	9-12 months
Beans (string)	Feb.-Apr. after frost	2-3 months
Beets	Aug.-Oct., Jan.-Apr.	3-5 months
Broccoli	Same as spring or winter cabbage.	
Brussels sprouts	Same as last.	
Cabbage	For early spring, Sept.-Oct.	3-7 months
"	—For summer and fall, Feb.-Mar.	3-4 months
"	—For winter, June-August	4-5 months

Cauliflower—Same as spring and winter cabbage.
Carrot—Any month except June and July ..... 4-6 months
Celery—Feb.-Apr. (in boxes) ..... 6-8 months
Celeriac—Same as celery.
Chard—Same as beet.
Chive (Cive)—Same as onion; sets or clumps.
Corn (sweet)—Mar.-June, Aug.-Sept. ..... 2-3 months
Collards—Same as summer cabbage.
Corn salad—Aug.-Oct., Jan.-Apr. ..... 6-8 weeks
Cucumber—Mar.-May ..... 2 months
Endive—Aug.-Apr. ..... 6-8 months
Garlic—Nov.-Mar., sets ..... 6-8 months
Kale (Borecole)—Aug.-May ..... 4-6 months
Kohlrabi—Aug.-Nov., Jan.-Apr. ..... 4 months
Leek—Sept.-May ..... 6 months
Lettuce—Aug.-May ..... 4-6 weeks
Okra (Gumbo)—Mar.-May ..... 2-3 months
Onion—Seed, Feb.-May, Aug.-Nov. ..... 9-12 months
" —Sets, Oct.-Apr. ..... 2-3 months
Parsley—Aug.-May ..... 2 months
Parsnip—Aug.-Nov., Feb.-Apr. ..... 8-16 months
Peas—Every month ..... 2-5 months
Peppergrass (Cress)—Aug.-May ..... 4-6 weeks
Potato, Irish—Plants, Feb.-May, Aug.-Sept ..... 2-4 months
Potato, Sweet—Plants, Apr.-May ..... 3-4 months
Radish—Every month ..... 1-2 months
Radish (winter)—Aug.-Sept. ..... 4 months
Rhubarb—Plants, Nov.-Apr. ..... 1 year
Salsify—Feb.-Apr. ..... 6-8 months
Spinach—Every month ..... 6-10 weeks
Sweet Potato—Plants, Apr.-June ..... 4-6 months
Tomato—Seeds, Feb.-Apr. ..... 3-5 months
" —Plants, Mar.-May ..... 3-5 months
Turnips—Aug.-Nov., Feb.-Apr. ..... 3 months

Annual Flowers.

Name.	*Time to plant.*	*How long to grow.*
Aster	Jan.-Feb. (boxes), Mar.-Apr., Aug.-Oct.	5-7 months
Balloon Vine	Mar.-Apr., after frost	Rapid climber
Balsam	Feb.-Mar.	4 months
Bean (Scarlet Runner)	Apr.-May	2-3 months
Calliopsis	Oct.-May	3-4 months
Chrysanthemum	Feb.-Mar.	3-5 months
Clarkia	Sept.-Nov., Feb.-Mar.	4 months
Collinsia	Sept.-Nov., Feb.-Mar.	3 months
Coreopsis	Sept.-Nov.	8-10 months
Cosmos	Oct.-June	3-4 months
Dianthus (Pinks)	Sept.-Oct. (beds)	3 months
"	—Jan.-Mar. (boxes)	3 months
Gilliflower (see Stock).		
Godetia	Dec.-Feb.	4 months
Gypsophila muralis (Baby's Breath)	Jan.-Mar.	3-4 months
Hyacinth	Bulbs, Sept.-Jan.	Spring flowering
Japanese Hop	Mar.-Apr.	Rapid climber
Larkspur	Sept.-Mar.	3 months
Lobelia (dwarf)	Aug.-Oct., Mar.-May (boxes)	3 months
Marigold	Jan.-Mar.	4 months
Mignonette	Sept.-Mar.	2-3 months
Mina lobata (climber)	Feb.-Apr.	6 months

Morning Glory (climbing)—Feb.-Apr. ..... 3 months
Narcissus—Bulbs, Sept.-Jan. ..... Spring flowering
Nemophila (Baby Blue Eyes)—Feb.-Apr. ..... 2-3 months
Nigella (Love-in-a-Mist)—Sept.-Mar. ..... 3 months
Pansy—Sept.-Oct. (boxes), Jan.-Mar. ..... 3-4 months
Phlox drummondii—Sept.-Mar. ..... 3-4 months
Platystemon (Cream Cups)—After first rains ..... 3 months
Poppy—Sept.-Nov., Feb.-Mar. ..... 3-4 months
Salpiglossis—Feb.-Apr., Sept.-Oct. ..... 3 months
Scabiosa—Sept.-Oct. (boxes), Feb.-Apr. ..... 4 months
Snail Vine—Spring after frost ..... 6 months
Stock, Ten Weeks—Aug.-Sept., Jan.-Mar. (boxes) ..... 3 months
Sweet Pea—Sept.-Feb. ..... 4-6 months
" —Early varieties, Aug.-Feb. ..... 3-4 months
" —Dwarf varieties, Sept.-Feb. ..... 4-6 months
Zinnia—Feb.-Apr. ..... 3 months

Perennial Flowers.

Name.	*Time to plant.*	*How long to grow.*
Bellis (Double Daisy)	Feb.-Apr., Aug., Sept.	6-8 months
Columbine	Sept.-Oct.	9 months
Canna	Seeds, Feb.-Mar. (boxes); Apr.	8-10 months
"	—Tubers, spring	2-3 months
Canterbury Bells	Aug.-Sept., Mar.-May	12 months
Carnation	Sept.-Oct. (beds); Nov.-Apr. (boxes)	6-12 months
Centauria (Dusty Miller)	Mar.-May (boxes)	Ornamental plant
Chrysanthemum	Plants, Apr.-June	5-6 months
Daisy	Sept.-May	3 months
Dahlia	Seeds, Jan.-Mar. (boxes); Apr. (beds)	7-10 months
"	—Roots, Mar.-May	5 months
Freesia	Seeds, Feb.-Apr.	2 years
"	—Bulbs, Sept.-Nov.	4 months
Forget-Me-Not	Sept.-Nov., Mar.-May	6 months
Gladiolus	Seeds, Feb.-Apr.	2 years
"	—Bulbs, Sept.-Dec.	3 months
Foxglove	Sept.-Nov., Mar.-May	8-10 months
Goldenrod	Seeds, Jan.-Mar.	1 year
"	—Plants (division)—Nov.-Jan.	6 months
Gypsophila paniculata	Jan.-Mar.	4-6 months
Heliotrope	Apr.-May (boxes)	4-6 months
Hollyhock (biennial)	Sept.-Oct., Mar.-Apr.	12 months
Marguerite (see Chrysanthemum).		
Passion Flower	Sept.-Mar.	Rapid climber
Perennial Pea	Sept.-Mar.	4-6 months
Perennial Phlox	Sept.-Nov., Mar.-May	6-8 months
Perennial Poppies	Sept.-Nov., Mar.-May	6-8 months
Pinks, China	Mar.-Apr.	3 months
Salvia (Flowering Sage)	Feb.-Mar. (house), Apr.-May	6 months
Shasta Daisy (see Chrysanthemum).		
Smilax	Seeds, Jan.-Mar. (boxes)	8-10 months
"	—Tubers, any time	2-3 months
Snapdragon	Aug.-Oct., Mar.-Apr.	3 months
Sweet William	Aug.-Oct., Mar.-May	2 years
Tulips	Bulbs, Nov.-Jan.	Spring flowering
Violet	Seed, Sept.-Mar.	3-4 months
"	—Plants, any time.	
Wallflower	Jan.-Mar.	6-8 months

Plants that will Thrive with Comparatively Little Water.

Vegetables.

Name.	*Time to plant.*	*How long to grow.*
Corn (sweet)—Mar.-June, Sept.-Oct.	(Give good cultivation)	2-3 months
Eggplant—Mar.-Apr. (boxes)		3 months
" —May-June (beds)		3 months
Melons—March to June after frosts		3-4 months
Peppers (chillies)—Jan. (boxes); April		4 months
Pumpkin—March-June after frosts		5-6 months
Squash—March-June after frosts		5-6 months

Flowers.

(All annual except those labeled otherwise.)

Name.	*Time to plant.*	*How long to grow.*
Alyssum, Sweet—Oct.-Dec.		2-3 months
Australian Pea Vine—Mar.-Apr.		3-4 months
Calendula "Pot Marigold"—Oct.-Apr.		2-3 months
Candytuft—Oct.-May		3-4 months
Castor Bean (P.)—Mar.-June		3 months
Centaurea (Corn Flower)—Feb.-May, Aug.-Oct.		3 months
Collinsia—Sept.-Mar.		2-3 months
Eschscholtzia (California Poppy)—Sept.-Mar.		3 months
Feverfew (P.)—Oct.-Dec.		6 months
Flax, Scarlet—Sept.-Oct., Feb.-May		3 months
Four O'Clock—Sept.-Mar.		2-4 months
Gaillardia—Mar.-May		4 months
Geranium (P.)—Seed, Sept.-Nov.		4-6 months
" —Cuttings, any time.		
Gilia—Sept.-Nov.		3-4 months
Godetia—Oct.-Dec.		3 months
Lavender (P)—Cuttings, Nov.-Feb.		2 years
Lippia repens (P)—(Lawn plant), Seeds, Oct.-Feb		6 months
" Plants (rooted cuttings), any time.		
Lupins (A & P)—Oct.-Dec.		3 months
Morning Glory (dwarf)—Feb.-Apr.		2-3 months
Nasturtium—Sept.-Apr.		2 months
Portulaca—Feb.-Apr.		2½ months
Petunia—Feb.-Apr. (after frost)		3 months
Sunflower—Any time		3 months
Pentstemon (P)—Oct.-Dec.		4-6 months
Plumbago (P)—Plants any time		Bush or climber
Salvia (Scarlet Sage)—Apr.-May; Sept. (boxes); Feb. (house)		4-6 months
Solanum jasminoides (P), (Potato Vine)—Plants, any time		10-20 feet
Verbena (mostly P)—Seeds, Oct.-Mar. (Dec.-Feb. in boxes); cuttings, Sept.-Mar.		4-5 months

Where to Obtain Seeds and Bulbs.

1. The School Garden Association, Grace I. Gay, Secretary, 501 Pierce Building, Boston, Mass., will furnish seeds in single packets or in collections at one cent per packet. Order lists and planting directions sent free upon request.

2. Certain seed dealers take so much interest in the school garden movement as to make special arrangements for supplying seeds to schools in penny packets.

a. Morris and Snow Seed Company, 425 South Main street, Los Angeles, will supply the following varieties at the rate of one cent per packet, if ordered for school garden purposes. Each packet will contain enough seed so that a row from 6 to 20 feet long can be made of each.

VEGETABLES.

Beets	Lettuce	Radish
Carrots	Melons, Musk	Spinach
Cucumber	Melons, Water	Turnips
Kale	Parsley	

FLOWERS.

Alyssum	Calliopsis	Morning glory
Candytuft	Linum (flax)	Mignonette
Cosmos	Marigold	Poppy

b. The Theodosia B. Shepherd Company, Ventura, will supply the following varieties of flower seed at one cent per packet on bona fide orders from school children. Teachers endorse orders.

Abutilon	Geranium
Anchusa capensis	Gypsophila (Baby's Breath)
Arctotis grande	Heliotrope
Begonia semperflorens	Ipomoea, Heavenly Blue
Begonia Rex	Ipomoea, White Tassel
Cactus, mixed	Mignonette
Calliopsis	Nasturtium
Centaurea	Petunia Fringed Hybrids
Coboea, scandens	Poppy, Fayal
Coleus	Poppy, Irresistable
Dahlia, Lily	Poppy, Maid of the Mist
Daisy, Blue	Poppy, Shirley
Daisy, Shasta	Stocks or Gilliflowers
Eschscholtzia, Golden West	Sweet Peas

c. Miss K. O. Sessions, P. O. Box 713, San Diego, will supply seeds to teachers in San Diego County for children's gardens at the rate of one cent per packet. San Diego teachers should write to Miss Sessions for the list of seeds offered.

d. James Vicks Sons, Rochester, N. Y., will supply seeds for children's gardens in penny packets as follows:

Fig. 10.—Redlands school gardens in early spring, 1907.

FLOWER SEEDS.

Asters	Morning Glory
Alyssum	Nasturtium, Climbing
Bachelor's Button	Petunia
Calliopsis	Phlox
Candytuft	Poppy
Dianthus	Scabiosa
Marigold	Sweet Peas
Mignonette	Zinnia

VEGETABLE SEEDS.

Beans	Onions
Beets	Raddish
Carrots	Spinach
Lettuce	Sweet Corn

Postage two (2) cents extra for every twelve (12) packets of flower seeds, and three (3) cents extra for every twelve (12) packets of vegetable seeds. Large orders will go cheaper by express, charges to be paid by purchaser. No order for less than one dozen packets accepted.

3. Bulbs are exceedingly satisfactory especially for the younger pupils. Carl Purdy, Ukiah, offers the following varieties of bulbs at the rate of one cent each in orders from teachers amounting to not less than one dollar; Narcissus poeticus, Anemone (St. Bridgits), Ranunculus, Crocus, Gladiolus (The Bride), Late Tulips, Spanish Irises. See planting directions on page 38.

4. The Federation of the Tree Growing Clubs of America, H. A. Greene, President, Monterey, Cal., will supply tree seeds free except postage to teachers for use in school grounds or gardens or for home planting by pupils.

5. The United States Department of Agriculture is authorized by Congress to distribute seeds free for trial. A limited quantity is usually sent to each postoffice, but the better way is to make application to the representative in Congress from your district.

6. The Agricultural Experiment Station, Berkeley, offers seeds of new varieties for introduction at a nominal price. Write to the Director for printed circular.

INSTRUCTIONS FOR TEACHERS BEGINNING GARDEN WORK.

SELECTION OF LOCATION.

For the sake of convenience and economy of time, the garden should be as near the school as possible. But some city schools have found it necessary to utilize vacant lots situated some distance away. When the garden is to occupy a portion of the school yard, several things should be kept in mind in selecting the site.

The *land* should be as nearly level as possible but well drained. The ideal soil is a deep loam, rich in humus, containing sufficient clay to give it lasting qualities and sand enough to make it friable. Heavy clay or "adobe" soil will be improved by having sand added at the rate of a two-ton wagon load to the square rod. This quantity should be spaded in to a depth of at least eight inches. If weeds are growing upon the land when the site is selected, the soil will be greatly benefited by having the vegetation plowed under while it is still green. This will increase the humus in the soil, and to keep the humus content high is of vital importance in soil that is to be continually cropped. If a certain part of the school yard has decidedly better soil than the rest, much should be sacrificed if necessary to secure the best for the garden. Only those gardeners who have had to struggle against the handicap of a refractory soil can appreciate the full import of this.

The *water supply* should be near at hand and, if possible, enough hydrants should be provided so that pupils will not have to carry water far or wait long to fill watering cans.

Protection from dogs and other animals should be provided in the shape of a wire netting fence, or a barbed wire fence with the wires set close near the surface of the ground. An oblong or square enclosure is preferable to a narrow strip.

The *size* of the garden should be as large as possible. The usual size of children's gardens today is far too small. The larger the individual plot, the greater the responsibility, and the more satisfactory will be the results, with due proportion of time and work.

Laying Out Gardens.

(The following directions for laying out gardens were kindly furnished by Mr. C. T. Wright, at that time Supervisor of Geography in High and Grammar Schools in Redlands.)

First Day.

Apparatus. Stakes, cords (mason's line), rocks or hammers to drive stakes into the ground, steel tape or marked cord.

Each cord is placed around one block of gardens lying *end to end.* Pupils pass in line up and down the paths thus marked out, dragging their feet on the first round to level down the ground, tramping on succeeding rounds to render the paths hard.

The cords are then changed so as to run in the opposite direction, each cord being placed around a block of gardens lying *side by side*. Paths are tramped as before.

Pupils take their places, each at the end of a garden, say the west end and face east. Each pupil should get two stakes and a rock or hammer to drive the stakes. The teacher and an assistant or two pupils stretch the measuring line across the ends of the block of gardens in front of the row of pupils. Each pupil drives a stake at the northwest corner of his garden, placing it accurately by the measuring line. This stake should have one smooth side for writing a name, and this smooth side should be toward the west. Similarly each pupil places a stake at the southwest corner of his garden. In a similar way other pupils place stakes at the heads of another row of gardens, and so on until all the gardens are marked out in this way.

Second Day.

Apparatus. Garden rakes, rulers, measuring line (steel tape), cords (mason's line).

The teacher assigns one garden to each pupil. The pupil writes his name on the west side of the stake at the northwest corner. In writing his name the pupil should stand so as to begin the name at the top of the stake. Pupils remove all sticks and stones from the gardens. This material may be piled up in the path at the side of each garden until the pupil is ready to remove it. In removing it the pupil should *carry* it. He should *never throw* it from his garden. Use rakes and dig up the soil as deeply as possible, removing by hand any sticks and stones. In digging, the pupil should hold the rake below the middle of the handle; in raking it may be held near the middle but usually not above the middle. Near the center of the garden, the work can be best done if the pupil will stand in the path at the side of the garden, and not at the end as some will do. The pupil should rake the surface of his garden thoroughly, until the soil is thoroughly pulverized. The surface should be left perfectly level and smooth. In laying aside the rake always put the *teeth down*.

Rulers may be used to scrape up any loose soil from the path, leaving the path smooth and level and as hard as possible. The loose soil thus scraped up may be scattered evenly over the entire garden, or carried to the fence and thrown over. The

edges of the garden should stand up as nearly straight as possible from the path. The garden should be bounded by perfectly straight lines. The mason's line may be stretched across the entire plot to test the straightness of the lines and to enable pupils to correct mistakes.

Third Day.

Apparatus. Stakes, ruler (yard stick) for teacher's use, cords (mason's line), seeds, sprinkling pots.

Teacher stretches cord across the end of all the gardens on one block, six inches from the head of each garden. Each pupil makes a furrow across his garden. This should be on the side of the string next to the head of the garden and as near to the string as possible without moving the string. The depth of the furrow is to be determined by the kind of seed to be sown. Pupil plants seeds according to the instructions given at the time, covers them, and applies water. It is better to apply water as late in the afternoon as possible. Water should never be put on so abundantly that it runs off. Water only that portion of the garden which has been planted. The remainder of the garden may be raked if necessary. The paths should be left clean, smooth and as hard as possible. Care should be taken to preserve the straight lines of the sides and ends of the gardens. Neglect to water the planted portion of the garden may prove fatal to the young plants.

Preparation of Soil.

The directions for pupils, for the second day in the above outline, obviously call for some preliminary preparation of the garden as a whole. If a green crop has been plowed in some time previous to the laying out of plots, the land should be well harrowed to pulverize and level the surface. If the tract is properly spaded when the soil is friable, it will be in condition to proceed as above directed. If possible a top-dressing of rotted stable manure should be applied before spading or plowing.

Planting Seeds.

The question of how deep to plant seeds will confront every would-be gardener, and yet it is impossible to set forth any general rule, to be followed with all seeds, in all kinds of soils, and at all seasons of the year. A seed is a living, embryonic

plant, existing in dormant condition, and protected by its coverings. In order that seeds shall germinate, they must be given moisture and a certain degree of warmth, the required amount of each depending upon the kind of seed. Under California conditions, especially when water is to be applied artificially, the thing of highest importance is to provide for uniform moisture conditions, and to prevent surface baking of clayey soils. Providing a light mulch, or giving shade by using tree prunings or other litter, will secure this end. The soil should be thoroughly and deeply moistened, but friable and finely pulverized, when the seeds are planted. The old rule of planting seeds at a depth equal to twice their diameter might be a safe one to follow under ideal conditions, but ordinarily, in the open ground, three or four times that depth will be safer.

The season of the year, since it affects the temperature, has much to do with percentage of germination. Bailey says that sometimes lettuce and melons which germinate only 50 per cent. in December will germinate 70 or 80 per cent. in April. This principle has been kept in mind in arranging the planting guide, and the chief reason for recommending planting in boxes is that they can be kept indoors at a higher temperature than in the open. At the same time, planting in boxes or seed-beds is advantageous with many other seeds besides those so indicated in the guide, as, for example, asters or tomatoes, because conditions can be regulated more easily and, in transplanting, the best plants can be chosen and planted out far enough apart to insure a good bedding effect or maximum yield.

For satisfactory germination most seeds should be less than one year old. Most seedsmen are conscientious in regard to selling only fresh seed, that has been tested for a high percentage of germination. If seeds fail to germinate under quite favorable conditions, it is probably due to low viability. Such seed may be tested by means of a simple contrivance (16, *d*, p. 27). In providing seed for extensive gardens, it would be well to test it beforehand, unless it is sold under guarantee. However, according to Bailey, some seeds, like melons, pumpkins, and cucumbers, retain their vitality unimpaired for a number of years, and "seeds of corn salad should be a year old to germinate well."

Stratification is necessary for most seeds of fruit and nut trees. The essential points in this operation are to supply uni-

form but not excessive moisture, and moderately cool temperature (or even freezing for some hard seeds of hardy plants) over a period of several weeks or months. This condition is most easily secured in the open by burying the seeds and covering with six inches of sand. When the seeds begin to sprout they should be taken out and planted in place or in nursery rows. Many seeds, as peach, almond, and walnut, will give a fairly good stand if planted in the fall in the nursery row at a depth of six or eight inches. But there will always be a certain proportion that do not germinate until the second year.

Careful planting always pays, especially with the small seeds. If possible, they should be sown in boxes or special beds. Level the surface before sowing, and cover the seed by sifting on the top layer and pressing the surface gently with a flat block of wood. When watering, spray the surface gently or first cover with burlap. Give partial shade at all times, and when the seedlings show the second pair of leaves transplant into boxes or pots, from which they can be shifted to the open ground. These directions apply to all the small-sized tree seeds as well as flower seeds.

Planting Bulbs.

The following directions for planting and future care of bulbs were furnished by Mr. Carl Purdy. (See statement of his offer of bulbs at the price of one cent each, to school children, p. 33.)

Narcissus poeticus ornatus. Any but very dry, sandy, or gritty soil, but thrives best in moist and heavy soils, especially clays. Work the soil twelve inches deep. Plant with the top of the bulb three inches deep, set four inches apart each way. Water thoroughly until after bloom, if weather is dry. Dry off in summer and leave three years before resetting.

Anemone (St. Bridgits). Best soils should be very loose and light. To secure this condition use old manure, rotten chips, old sawdust, or leaf mould. Plant in fall, two inches deep, and three inches apart each way. Water if dry. Ripen off after flowering, and leave several years without resetting.

Ranunculus. Same soil and treatment as for Anemone.

Crocus. Plant in fall, two inches deep, and three inches apart each way. Best soil, sandy or light loam. If soil is heavy, lighten as for Anemones. Leave alone three years, then reset.

Gladiolus (The Bride). A sandy or loamy soil best suits them, but any well-drained soil will do. Set three inches deep and four inches apart each way. Plant in fall or until January 1st. If dry, water well until a month after flowering. Reset second year.

Late Tulips. Best soil, a well-drained loam, either sandy or clayey. A wet soil will not do at all. Remove soil to seven inches depth, and at bottom put an inch of well-rotted manure. On this put two inches of the soil, and plant the bulbs so that they will be covered three inches deep. Water thoroughly from the time that the buds show until three weeks after bloom. Dig when leaves turn yellow. Plant in early fall.

Spanish Irises. Best soil, a heavy loam. Lighter or heavier soil will do if drainage is good. Plant like Narcissus. Do not lift until clumps get too thick. Water well after buds show.

General Note.—To get the best flowers from any of the above bulbs, there should be light shade. The east or west side of a building will do; or, better, some point where, in April, the shade of a deciduous tree strikes the bed from a third to half the day.

Gophers will eat any of the above excepting Narcissus. If necessary, they can be planted in a box sunk in the ground.

Planting Shrubs and Trees.

The following concise directions for planting shrubs and trees are copied from the 1909 catalogue of the American Forestry Company, South Framingham, Mass.: "Before planting, the roots should be thoroughly soused in a 'puddle' made of rich, fine earth or black muck, and water, mixed to the consistency or ordinary paint. The plants should be carried to the field either in a bucket containing puddle or water, or in a basket with burlap or some such covering to protect the roots, previously puddled. Any very long, superfluous roots should be cut off with a sharp knife or cleaver. In the case of small hardwood seedlings, with a strong tap-root, cut the tap-root back to a length of eight or ten inches, making a downward, slanting cut. *There must be no exposure of the roots to the sun or drying wind, before setting, as plants are almost surely killed in this way; this is especially true of evergreens.* In setting the trees, two men work together, one carrying the plants

and setting them, the other making the holes. The best all-round digging tool is the double-edged cutting hoe, or mattack. While one man makes the hole, the second man (or boy) places the plant in the hole with the roots straight down and spreading in a natural position. The best well-broken or 'fined' soil must then be packed so solidly about the roots as to make them air-tight. The plant should be set about one inch deeper than it was originally in the nursery, to allow for the settling of the ground; after settling, it should be just as deep as it was in the nursery. Great care must be taken *not to set small plants too deep,* especially in heavy soils. The roots can hardly be packed too firmly. For plants set in early spring, the ground is usually damp enough, but if they are set very late, or if a drought follows immediately, it may be necessary to water them." (It will certainly be necessary in most parts of California.)

The above directions refer to large plants, such as one would buy from a nursery. In handling seedlings of one's own growing, they should be in cans or small boxes which may be left intact or partly loosened, without disturbing the roots, when the plant is set in its permanent location.

Value of Furrow Irrigation.

The economical use of water is one of the most important principles that can be inculcated by means of the school garden. The advantage of soaking the soil about once a week and then tilling it, rather than sprinkling the surface every day or two, has been mentioned. The economy of water may be still further insured by practicing furrow irrigation. To quote from Hilgard's "Soils": "Evidently this is a much more rational procedure than surface flooding, as it tends to leave most of the surface in loose tilth, while penetrating to much greater advantage, because of the ready escape of the air from the soil. It is the system almost exclusively used in truck gardens and orchards, and generally where crops are grown in drills or rows sufficiently far apart to permit of cultivation." The desirability of furrow irrigation should be kept in mind, therefore, when planning the arrangement of the individual gardens of the children, so that space may be allowed for this method of watering. The trenches may be made with a hoe, and should be filled two or three times in succession to insure copious sub-irrigation.

After the water has disappeared, the furrows may be closed at once with dry earth, if the surface soil on either side has not been soaked. Thus the necessity of spending a period in the garden on the following day may be lessened. This is a feature worth considering in schools where the time for gardening is necessarily limited. Moreover, there are other important principles connected with this mode of irrigation, such as insuring the deep rooting of plants, and prevention of surface baking, and loss by evaporation.

Cultivation.

To keep a surface mulch of finely pulverized soil so as to reduce evaporation to a minimum is the chief purpose of cultivation. A hoe or a rake, according to whether the soil is clayey or sandy, is the best tool to use. Cultivation should be practiced after each rain or thorough sprinkling. But the soil should not be stirred until it has dried sufficiently to crumble readily. If the soil is inclined to set or pack below the surface, it should be stirred more deeply so as to improve its physical condition and allow better root development.

Time Necessary for Garden Work.

Although children often become so enthusiastic as to be willing to work in their gardens outside the school hours, it is well to have some regular gardening periods, when the teacher can supervise, suggest and correct. As Professor Jackman says, "Odds and ends of time will not do—the weeds do not grow by fits and starts." In some schools part of the regular nature-study periods are set aside for gardening. In the Los Angeles Normal School, in 1906-7, two hours per week for each pupil were found to be sufficient to keep the plots neat and the plants flourishing. It will save much time and labor on the part of the children if the garden has been plowed and harrowed before the garden work begins. In general, pupils should be encouraged to devote as much time as they will to this work.

The Garden During Vacation.

It is highly desirable that some provision be made for the appearance of the school garden during the long vacation. A deserted or neglected garden is a standing reproach against its

Fig. 11.—Pupils of the Los Angeles Normal School Training Department, working in their plots.

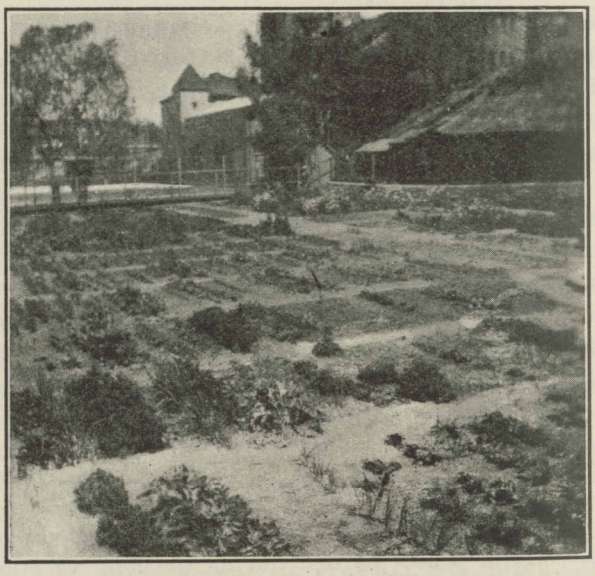

Fig. 12.—Training school gardens at Los Angeles Normal School in 1907.

owners. Therefore, if nothing else can be done, remove all plants that may not grow without attention, and leave the land bare. A more desirable plan would be to provide for the necessary labor by calling for volunteers among the older pupils. The planting of fall-blooming herbs, shrubs, and vines in borders and along fences may be conditioned upon such an agreement on the part of the children. However, it may be possible to secure an appropriation from the school board which will obviate the necessity of depending on volunteers.

How to Secure Special Preparation for Teaching Nature-Study within California.

(1) The State Normal Schools. Special work in nature-study and gardening can be arranged at each of the normal schools, at San Diego, Los Angeles, San Jose, and Chico. The gardens at two of these institutions are illustrated in figures 1, 6, 9, 11, 12, 13, 14.

(2) The University of California.

(*a*) Bulletins, including reading courses in entomology and irrigation.

(*b*) Farmers' Institutes.

(*c*) Short Courses at the University Farm. (See Circular No. 45.)

(*d*) The Summer Session of the University at Berkeley. (See regular Announcement, to be obtained from the Recorder of the Faculties.)

(*e*) Regular or special course, including studies in education, natural science, and agriculture.

(3) The California Polytechnic School at San Luis Obispo offers a secondary course in agriculture and domestic science, from one to three years in length, which should give definite preparation for the teaching of elementary subjects.

Any person who contemplates doing special work in agricultural nature-study should consult the recent report of Professor L. H. Bailey upon this subject (17) and Crosby's paper on "Training Courses for Teachers of Agriculture" (14).

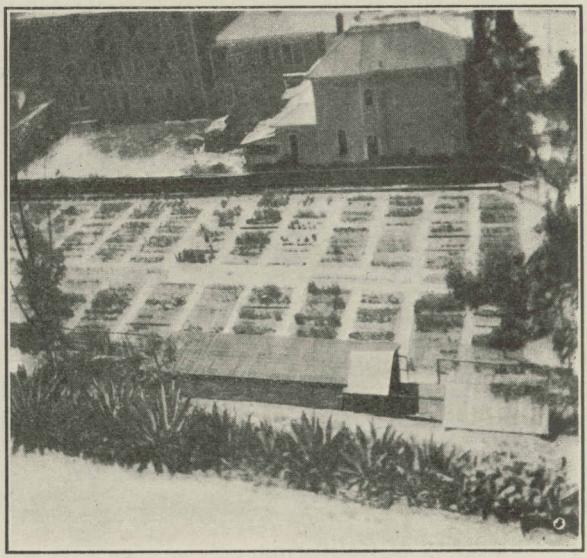

Fig. 13.—View of gardens at Los Angeles Normal School showing lath house and glass house in foreground.

Fig. 14.—Student teachers' class in gardening at the Los Angeles Normal School, 1907.

List of Works Referred to by Numbers in this Circular.

1. "Agricultural Education, including Nature-Study and School Gardens," by J. R. Jewell. Department of the Interior: Bureau of Education, Bulletin No. 2, Whole Number 368; Washington, D. C.
2. "School Gardens for California Schools," by B. M. Davis. Bulletin No. 1, Chico State Normal School. Price, 30 cents.

3a. "The School Garden," by L. C. Corbett. Farmers' Bulletin 218. Sent free by The Secretary, U. S. Department of Agriculture, Washington, D. C.

b. "School Gardens," by B. T. Galloway, Chief of Bureau of Plant Industry. Office of Experiment Stations, Bulletin No. 160, U. S. Department of Agriculture, Washington, D. C. Price, 10 cents.

4. First Annual Report, International Children's School Farm League (1907). Sent on application to the Secretary, 29 West Fifty-sixth street, New York City.

5. These and No. 6 can be obtained free of charge by sending to The Secretary of Agriculture, Washington, D. C.

a. "The Teaching of Agriculture in the Rural Common Schools," by Committee of Five. Circular 60, Office of Experiment Stations.

b. "Country Life Education," by W. M. Hays, Assistant Secretary of Agriculture. Circular 73, Office of Experiment Stations.

c. "Introduction of Elementary Agriculture into Schools," by A. C. True, Director of the Office of Experiment Stations. Reprint from Year-Book of the U. S. Department of Agriculture for 1906.

6. "Progress in Agricultural Education, 1906," by D. J. Crosby. Reprint from Annual Report, Office of Experiment Stations, ended June, 1906. Pages 281-287 treat especially of school gardens.

7. "Why the Friends of Agricultural Progress Believe that Agriculture Should and Will be Taught in the Public Schools," by A. C. True. Circular No. 16, Experiment Station, Berkeley. Free.

8. "School Gardening," by D. R. Wood. California Education, Vol. I, No. 2, March, 1906; A. Sherriffs, 457 North Third street, San Jose, Cal. Price, 40 cents.

9. "Outline of Course in Nature-Study," by L. H. Miller and E. B. Babcock. Bulletin, State Normal School, Los Angeles, Cal. Free.

10a. "Notes on Dry Farming," by W. M. Jardine. Circular No. 10, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C. Free.

b. "Dry-land Grains," by W. M. Jardine. Circular No. 12, Bureau of Plant Industry, Secretary of Agriculture, Washington, D. C. Free.

c. "The Use of Small Water Supplies for Irrigation," by S. Fortier. Separate 458. Year-Book of U. S. Department of Agriculture, 1907. Secretary of Agriculture, Washington, D. C. Free.

d. "Suggestions for Arbor Day Planting." (Trees and shrubs suited to Arizona and parts of California.) Circular No. 62, Agricultural Experiment Station, Tucson, Ariz.

11a. "Eucalyptus in California," by N. D. Ingham. Bulletin No. 196, State Agricultural Experiment Station, Berkeley. Free.

b. "A Handbook for Eucalyptus Planters," by G. B. Lull, Circular No. 2, State Board of Forestry, Sacramento, Cal. Free.

12a. *California Seedsmen and Nurserymen, partial list.*
C. C. Morse & Co., Successors to Cox Seed Co., San Francisco.
Carl Purdy, Ukiah, Cal. (Imported and native bulbs.)
Germain Seed Company, Los Angeles.

Chas. Winsell, Los Angeles.
H. M. Sanborn, Oakland.
Aggeler & Johnson Seed Co., Los Angeles.
May Seed Company, San Francisco, Cal.
Miss K. O. Sessions, San Diego.
Morris & Snow Seed Co., Los Angeles.
Southern California Acclimatizing Association, Santa Barbara.
Theodore Payne, Los Angeles. (Seeds of native plants.)
Theodosia B. Shepherd Co., Ventura.
Trumbull Seed Co., San Francisco.

b. *Nurserymen who do not handle seeds.*
Abraham, C. C., 1600 Greenwich St., San Francisco.
Armstrong, John S., Ontario.
California Nursery Co., Niles.
Coronado Nurseries, San Diego.
Exotic Nurseries, Santa Barbara.
Fancher Creek Nurseries, Fresno.
Gill, E., West Berkeley.
Howard & Smith, Los Angeles.
Pacific Nursery, 3041 Baker St., San Francisco.
Pioneer Nursery, Monrovia.
Teague Citrus Nursery, San Dimas.

13. Report of the Committee on Industrial Education in Schools for Rural Communities to the National Council of Education, July, 1905; pp. 57-61.

14. "Training Courses for Teachers of Agriculture," by D. J. Crosby, Expert in Agricultural Education. Separate No. 445, Year-Book, 1907. Secretary of Agriculture, Washington, D. C. Free.

15a. "Boys' Agricultural Clubs," by Dick J. Crosby, Separate 362, Year-Book, 1904. Secretary of Agriculture, Washington, D. C. Free.

b. "The Art of Seed Selection and Breeding," by A. S. Shamel. Separate 446, Year-Book, 1907. Secretary of Agriculture, Washington, D. C. Free.

16a. "The Use of Illustrative Material in Teaching Agriculture in Rural Schools," by Dick J. Crosby. Separate 382, Year-Book, 1905. Secretary of Agriculture, Washington, D. C. Free.

b. "Experimental Studies of Plant Growth," by B. M. Davis, Bulletin, Miami University, Oxford, Ohio. Free.

c. "One Hundred Experiments in Elementary Agriculture for California Schools," by Riley O. Johnson. State Normal School Bulletin, Chico, Cal. Price, 30 cents.

d. "Exercises in Elementary Agriculture—Plant Production," by D. J. Crosby. Office of Experiment Stations, Bulletin 186. Price, 10 cents.

e. "Simple Exercises Illustrating Some Applications of Chemistry to Agriculture." Bulletin 195, Office of Experiment Stations. Price, 5 cents.

17. "On the Training of Persons to Teach Agriculture in the Public Schools," by Liberty Hyde Bailey, Department of the Interior: Bureau of Education, Bulletin No. 1, 1908, Whole No. 380.

18. "The Weather Bureau and the Public Schools," by John R. Weeks. Separate 471, Year-book, 1907. Secretary of Agriculture, Washington, D. C. Free.

19. "The Way to Grow Trees Yourself." Circular of information. The Federation of Tree Growing Clubs of America, H. A. Greene, President, Monterey, Cal.

20. List of Free Publications of the U. S. Department of Agriculture, Washington, D. C. Secretary of Agriculture. Free.

Publications of the Agricultural Experiment Station, University of California.

BULLETINS.

Reprint. Endurance of Drought in Soils of the Arid Region.
No. 128. Nature Value and Utilization of Alkali Lands, and Tolerance of Alkali. (Revised and Reprint, 1905.)
140. Lands of the Colorado Delta in Salton Basin, and Supplement.
142. Grasshoppers in California.
147. Culture Work of the Sub-stations.
149. California Sugar Industry.
150. The Value of Oak Leaves for Forage.
151. Arsenical Insecticides.
153. Spraying with Distillates.
154. Sulfur Sprays for Red Spider.
156. Fowl Cholera.
159. Contribution to the Study of Fermentation.
161. Tuberculosis in Fowls. (Reprint.)
162. Commercial Fertilizers. (Dec. 1, 1904.)
163. Pear Scab.
165. Asparagus and Asparagus Rust in California.
167. Manufacture of Dry Wines in Hot Countries.
168. Observations on Some Vine Diseases in Sonoma County.
169. Tolerance of the Sugar Beet for Alkali.
170. Studies in Grasshopper Control.
171. Commercial Fertilizers. (June 30, 1905.)
172. Further Experience in Asparagus Rust Control.
174. A New Wine-cooling Machine.
176. Sugar Beets in the San Joaquin Valley.
177. A New Method of Making Dry Red Wine.
178. Mosquito Control.
179. Commercial Fertilizers. (June, 1906.)
180. Resistant Vineyards.
181. The Selection of Seed Wheat.
182. Analysis of Paris Green and Lead Arsenic. Proposed Insecticide Law.
183. The California Tussock-moth.
184. Report of the Plant Pathologist to July 1, 1906.
185. Report of Progress in Cereal Investigations.
186. The Oidium of the Vine.
187. Commercial Fertilizers. (January, 1907).
188. Lining of Ditches and Reservoirs to Prevent Seepage and Losses.
189. Commercial Fertilizers. (June, 1907.)
190. The Brown Rot of the Lemon.
191. California Peach Blight.
192. Insects Injurious to the Vine in California.
193. The Best Wine Grapes for California; Pruning Young Vines; Pruning the Sultanina.
194. Commercial Fertilizers. (Dec., 1907.)
195. The California Grape Root-worm.
196. Eucalyptus in California.
197. Grape Culture in California; Improved Methods of Wine Making; Yeasts from California Grapes.
198. The Grape Leaf-Hopper.
199. The Bovine Tuberculosis.
200. Gum Disease of Citrus Fruits.
201. Commercial Fertilizers.
202. Commercial Fertilizers.

CIRCULARS.

No. 1. Texas Fever.
2. Blackleg.
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4. Anthrax.
5. Contagious Abortion in Cows.
7. Remedies for Insects.
9. Asparagus Rust.
10. Reading Course in Economic Entomology. (Revision.)
11. Fumigation Practice.
12. Silk Culture.
15. Recent Problems in Agriculture. What a University Farm is For.
17. Why Agriculture Should be Taught in the Public Schools.
18. Caterpillars on Oaks.
19. Disinfection of Stables.
21. The Advancement of Agricultural Education.
24. Olive Pickling.
26. Selection and Preparation of Vine Cuttings.
27. Marly Subsoils and the Chlorosis or Yellowing of Citrus Trees.
28. A Preliminary Progress Report of Cereal Investigations, 1905-07.
29. Preliminary Announcement concerning Instruction in Practical Agriculture upon the University Farm, Davisville, Cal.
30. White Fly in California.
32. White Fly Eradication.
33. Packing Prunes in Cans. Cane Sugar vs. Beet Sugar.
35. Southern California Pathological Laboratory and Citrus Experiment Station.
36. Analyses of Fertilizers for Consumers.
37. Announcement of Farmers' School Courses, 1908.
39. Instruction in Practical Agriculture at University Farm.
41. The School of Agriculture on the University Farm.
43. The School of Agriculture on the University Farm. Second year.
44. Opportunities for Instruction in Dairy Industry at the University Farm.
45. Farmers' Short Courses at the University Farm.

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