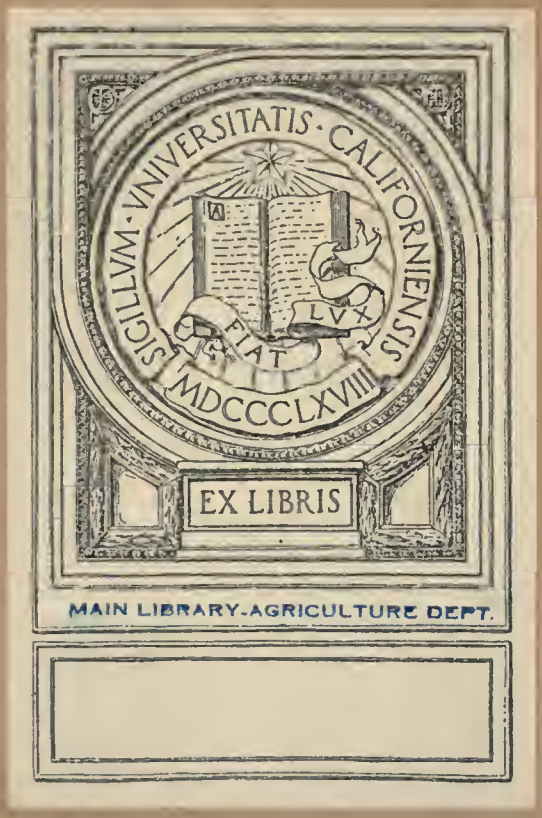

UNIVERSITY OF CALIFORNIA

COLLEGE OF AGRICULTURE

DIVISION OF AGRICULTURAL EDUCATION

TEACHERS' COURSE 100 - ELEMENTS OF AGRICULTURE, NATURE STUDY AND SCHOOL GARDENS. - O. J. Kern, Asst.Professor Agricultural Education.

Part I. Elements of Agricultural Nature Study.

AGRICULTURAL NATURE-STUDY, METHODS, MATERIALS, ETC.,

Educational Values.

1. Seeing Things:- "The more I think of it, I find this conclusion more impressed upon me, that the greatest thing a human soul ever does in this world is to see something. Hundreds of people can talk for one who can think, but thousands can think for one who can see. To see clearly is poetry, prophecy and religion- all in one." Ruskin.

2. Learning Things:- "Learning those things in nature that are best worth knowing, to the end of doing, those things that make life most worth living." Hodge.

3. Doing Things:- "The daily doing of needful things with regularity and efficiency is in itself highly educative. It constitutes a good and necessary part of a liberal education, and without it no system of education is safe. It teaches, first of all, personal responsibility for things to be accomplished, whereby the child learns the useful lesson that things do not 'just happen', neither do they 'do themselves'--" Davenport.

Place of Nature Study in a System of Education.

1. "We are not, neither shall we be, free from the need of and interest in the three fundamental human requisites, viz. food, clothing, and shelter. The poet and the philosopher cannot prosper on rhyme and speculation alone. They, as well as the scientist and the laborer, must have life before they have their own peculiar lives; they, too, must be fed, clothed and sheltered. We have here a center in which the interests of all humanity, converge. The poorest and the most ignorant have little more, and the most favored

have nothing that can be substituted for these same fundamentals. The need for biologic knowledge was the first and continues to be the primary need of life. To know in some way which things are for us and which against us, which will cure and which will kill; in short, to know the life with which and in which we live is our primary need. This is true not only chronologically but logically and biologically as well. There is no escape from it. If there is any truth in the 'recapitulation theory', and if the spontaneous interest of the child is to be a determining factor in the selection of material for the Kindergarten and elementary school, it would seem to be a serious error to omit those things which have been the earliest and most persistent elements in the development of the race and in which the child finds his greatest delight----The great text-book of Nature is open before us. In this both the race and the child find their primary and fundamental needs supplied, and their first and most abiding interest awakened. In the kindergarten and the elementary school, when practicable, the care and culture of animals and plants should be the first aim; when this is not practicable, association and acquaintance with them should be encouraged. This study should constitute the very core and heart of elementary education and should be secondary to no other phase of work".- Bryan, The Basis of Practical Teaching pp 143-146.

2. "Cultivation of plants indicated and developed elements of character fundamental to civilized life. Willingness to work for daily bread, intelligent provision for the future, courage to fight for home, love of country, are a few among the virtues attained. When we consider its universal and fundamental character in relation to civilization and

human advancement, the omission of soil lore from a system of education of the young is suggestive of relapse to barbarism. To allow a child to grow up without planting a seed or rearing a plant is a crime against civilized society, and our armies of tramps and hordes of hoodlums are among the first fruits of an educational system that slights this important matter." Hodge, Nature Study and Life p 10.

3. "As I see it, the object of teaching in the grades and especially in the country schools that superior quality of nature study which we may call agriculture may be briefly outlined as follows:-

1- To educate partly by means of that industry lying nearest at hand, to the end that the student may be active rather than passive - a doer as well as a thinker.

2- To widen the perspective and so far as possible to introduce the student to the real life of the world.

3- To instill a respect for industry in general.

4- To give some agriculture for its own sake as well as for its educational value in order that its fundamental need shall be appreciated and its practices improved. "-Davenport, Education for Efficiency, revised edition, p 144.

Introductory Study of Purpose, Principles, Etc.

References for Reading and Class Discussion.

1. Bailey, The Nature Study Idea.

2. Comstock, Hand Book of Nature Study for Teachers.

3. Coulter and Patterson, Practical Nature Study and Elementary Agriculture.

I- What Nature Study Is.

A. Bailey, Chap. I, pp 1-15.

1. A movement originating in the common schools for a specific purpose. Name it. See P. 4.

2. Nature may be studied with either oftwo objects. p 5.

3. Contrast of Nature-study method and formal science method.p 5.

4. Evolution of a new intention in Education p 11.

5. Things essential to teach nature. p 13.

B. Comstock Part I.

1. Observation and object of Nature-study teacher. p 1.

2. What nature study should do for the child. pp 1,2.

a. Cultivates child's imagination, perception and regard for what is true and power to express it. p 1.

b. Love of the beautiful-- perception of color, form, etc.p1.

c. Sense of companionship with out-door life. p 1.

d. Personal knowledge of nature's laws. p 2.

C. Coulter and Patterson. pp 1,2.

1- Nature Study's object. p 1.

2- Character of material how determined? p 1.

II- What Nature Study Is Not.

A. Bailey, Chapter III. pp 29-35.

1- Not the teaching of science-- not the systematic pursuit of a logical body of principles. p 30.

2- Not reading nature books. p 30.

3- Not the teaching of facts merely for the sake of facts. p 31.

4- Not a program for the teaching of morals. p 32.

5- Not the adding of one more thing to a course of study.p 33.

B. Comstock Part I. pp 5.

1- Not elementary science as so taught.

2- In elementary science work begins with what?

3- Work of nature study begins how?

4- Nature study for the child and science for the " grown-ups."

III. The Spirit of Nature Study.

A. Coulter and Patterson pp 60-72.

1- The " atmosphere" of nature study. p 61.

2- Value of enthusiasm p 61.

3- Danger of making enthusiasm the only test of an effective nature study spirit. p 61.

4- The kind of exactness that kills nature study. p 62.

5- The plea for the salvation of enthusiasm. p 62,63.

6- Value of the open mind. pp 64,65.

7- Need of a spirit of inquiry. p p 65,66,67.

a- "The childhood of the race accumulated much which its manhood is compelled to lay aside, and our mental stock in trade needs going over and revising continually."

b- "The Spirit of inquiry leads one to take the statements of books and of teachers as things to be tested before they are believed."

8- The desire for truth. pp 68,69.

9- Persistence pp 70-72.

a- "There are teachers of no experience or training in nature study, but with enthusiasm and persistence, who have worked over their local

material, until they are perfectly familiar with its possibilities, who have devised all sorts of useful schemes for interesting the children in uncovering it, and who have accumulated a stock of most suggestive experiments. In short, they are exceedingly successful; perhaps more so than if their opportunity for training had been greater. There are other teachers of high training whose lack of persistence makes them shrink at every trouble, even the trouble of devising something that they had not learned."

10- The special subject. pp 72-74

a- Need of a general view.

b- Intensive study in a special field.

c- Tendency of books and addresses, on nature study.

d- Special fields used to illustrate the principles of the general field.

e- Acquaintance with some particular subject.

B- Comstock pp 2-4

1- Nature study a tonic for teachers-nerves.

2- The only two occupations for a teacher on Saturday forenoon or afternoon. p 3.

3- How may a teacher find companionship with her pupils and health and strength for herself? p 3.

4- The spirit that enables the teacher to say, "I do not know." pp 3,4.-- "The chief charm of nature study would be taken away if it did not lead us through the borderland of knowledge into the realm of the undiscovered."

C- Bailey pp 59-66.

1- The teacher who hesitates to teach nature study because of lack of technical knowledge of the subject. p 59.

a- "The child wants things in the large and in relation; when it gets to the high school or college it may carry analysis and dissection to the limit."

2- Meaning of "The degree of statement is more important than final accuracy- if there is such a thing as final accuracy"- pp 60,61.

3- The well drilled young man and the perfect school laboratory. pp 62,63.

4- The man with an incomplete course. pp 63,64.

5- Distinction between natural science and a science of natural things. p 65.

6- When teach nature study and why? pp 65,66.

IV- Principles of Nature Study.

A. Bailey pp 37-50

1- How nature study may be taught. pp 37-40

a- The teacher and the object;

b- Help from books and leaflets;

c- Environment will suggest the work;

d- Need of great personal enthusiasm.

2- Factors determining the proper subjects for nature study instruction p 40.

a- "First, the subject must be that in which the teacher is most interested and of which he has the most knowledge."

b- "Second, it must represent that which is commonest and which can be most easily seen and appreciated by the pupil, and which is

nearest and dearest to his life."

3- The three steps in the teaching of nature study. p 42.

a- The fact;

b- The reason for the fact;

c- The interrogation left in the mind of the pupil.- illustrations pp 42-45.

4- The book as a nature-study subject. pp 45,46.

5- The teacher and way of teaching more important than the subject matter. p 46.

6- The mind of the child and the voices of nature. pp 46,47.

7- One of the first things a child should learn. pp 47,48.

8- A common mistake in teaching nature study. pp 48,49.

9- How nature study is not an additional burden to the teacherp49.

10- Change in procedure as children grow older. pp 49-50.

B. Coulter and Patterson pp 46-59.

1- Selection of material pp 47-48.

a- "The fundamental principle is to select the natural objects of most common experience-- those that thrust themselves upon the observation of everyone. For example, in a wooded region no natural object is more common than a tree, and in every region trees are at least associated with parks, or streets, or dwellings. It happens that tree studies call for somewhat special treatment, especially with lower grades, but they are not to be avoided on that account."

b- Neighborhood differences in material and neighborhood

differences in the experiences of pupils. p 47.

c- Need of the adaptable teacher. p 48.

2- Activity rather than Structure. pp 48-50

a- Activity the most important fact in reference to any organism. p 48.

b- "It is fundamental that all studies with plants and animals should rest upon the idea that organisms are at work; that life compels work."

c- Structure not to be omitted but that "all structure must be interpreted as to function as far as possible." Illustrations, structure of leaves, etc., p 49.

d- Warning as to dangers in wholesale claims of adaptations. p 49.

e- The fresh simple experiment versus "beans in every room." p 49.

f- Value of germination studies. p 50.

3- Definiteness of Purpose and Instruction pp 50,51.

a- "No material should be assigned that has not been traversed previously by the teacher, so that she knows that there are some very definite facts in plain sight."

4- Value of sketching in connection with Observational Work. p 51.

a- "The pedagogical value of sketching in nature study, however, lies in the effort to reproduce rather than in the accurate reproduction."

b- "Sketching should measure the thought behind it no more than does handwriting; both ought to be as good as possible, but both are subordinate."

5- Independent Observation. pp 52-53.

a- Classes of pupils during a general exercise; "Those who do not listen, those who do not observe, those who do not answer, and a few eager ones who do all the listening, observing and answering."

b- Individual work means individual responsibility.

c- Value of small groups in observations and experiments. p53.

d- Group system in primary grades.

6- Unprejudiced Observation. pp 53-55.

a- "Children in school are remarkably docile, and if told to see a thing, the majority of them will confess to seeing it."

b- Character of the more subtle form of prejudiced observation p 54.

c- Correcting the personal equations. p 54.

d- Honest contradiction based on honest observation. p 55.

7- Comparison of Results. pp 55-59.

a- Importance of the larger outlook and the intellectual result. p 55.

b- The most interesting way of comparing results. p 56.

c- "The next step comes so naturally that it is likely to be proposed by the pupils themselves." p 56.

d- Experience important to recognize the fact "that the

characters in common are the important ones, and that the characters whi[ch] differ are not so important, being only individual differences." p 57.

e- The development of caution. pp 57,58.

f- Teaching "the need and nature of adequate proof before a statement can be insisted upon very strenuously;" illustration p 58.

g- Hard task in teaching has been "to check the tendency of many students to use one fact for a starting point for a flight of fancy that is surprising." p 58.

h- How are facts like stepping stones? p 59.

C- Comstock pp 6-14.

1- When to give the Nature Study Lesson-- Two Theories p 6.

2- The Length of the Lesson p 7.

3- Newness of lesson versus repetition. p 7.

a- Justification of the boy who said; "Darn germination. I had it in the primary and last year and now I am having it again. I know all about germination."

4- Nature Study versus Object Lessons. pp 7,8.

a- What details are important?

b- "In nature study, the observation of form is for the purpose of better understanding life." p 8.

5- Nature study in the Schoolroom. p 8.

6- Nature Study and Museum Specimens pp 8,9.

a- When use common sense?

b- Value of making a collection of insects. p 8.

c- "To kill a creature in order to prepare it for a nature

study lesson is not only wrong but absurd, for nature-study has to do with life rather than death, and the form of any creature is interesting only when its adaptations for life are studied."

7- Helps in Nature Study. p 9.

a- Eyes first; small lens; "Microscope has no legitimate part in nature study"; field or open glasses of great help in bird study but "by no means necessary in nature study."

8- Pictures and Books, Charts, Blackboard Drawings. p 10.

a- When to use pictures and illustrated books?

b- "Taking everything into consideration, however, nature study charts and blackboard drawings are of little use to the nature study teacher."

9- How to Use Scientific Names. p 10.

10- The Use of the Story as a Supplement to the Nature-Study Lesson pp 10,11.

11- Rules for Making the Field Note Book a success. pp 13,14.

a- Especially observe last rule on top page 14.

12- How to avoid the Dangers of the Field Excursion. p 15.

V- Dangers of Nature Study.

A- Coulter and Patterson. pp 29-45.

1- The Teacher. pp 29-31

a- "The principal thing is not formal training in teaching nature study, although this is very desirable; or a university course in all the sciences involved; but the principal thing is the spirit in which nature study is taught".

b- Given the right spirit how will training and knowledge develop? p 30.

c- "The most obvious thing in a successful teacher of nature study is an enthusiasm for the work, and enthusiasm is one of the most contagious things in the world." p 31.

2- What Constitutes Dead Work? pp 31-33.

a- "As a salve to conscience the exercise was called 'busy work', instead of nature study, and that is a capital name for all dead work in nature study; work which keeps the pupils busy even if they are neither interested nor profited." p 32.

b- What are the most important things to observe about familiar objects? pp 32,33.

3- Confusion between "terminology" and Knowledge. pp 33,34.

a- "To learn the technical name of an object seems to satisfy the intellectual desire of most people in reference to it. As a well-known botanist said in reference to the naming of plants, once so much in vogue as botany; 'It is like chasing a woodchuck into his hole; one has only the hole to show for his effort.' p 33.

b- Observation of leaves. pp 33,34

c- How use a technical name. p 34.

d- "The method is more important than the matter. This is the attitude of mind that nature study should cultivate, rather than the idea that a name is the end-all". p 34.

4- Meaning of Factitious Interest. pp 34-36.

a- Personification and romance in books on nature study. p 35.

b- Correlation of nature study and literature is not nature study. p. 35.

c- Instruction in nature study must not be as exact and colorless as a mathematical formula - p. 36.

d- "To make nature live is one thing; to make the imagination lively and even wild is another."

e- Contrast of two teachers each telling the story of the winter bud and its awakening in the spring. p. 36.

5- Danger of Unwarranted Inferences pp 36-38.

a- Desire to explain everything. pp 36-37.

b- Meaning of perfect adaptation to environment pp 37, 38.

c- Which statement is correct as to flowers and insects? p 38.

6- Danger of Sentimentality. pp 38-40.

a- Sentiment versus sentimentality. p 38.

b- "It has been attempted to show that nature study can produce clarity of vision, exactness of statement, definiteness of conclusion in short the most practical qualities for successful living. If it can do all this it would seem a perversion to use it to increase the materials for mawkish sentimentality." p 39.

c- Responsibility of association of nature study with poetic literature. p 39.

7- Dangers of Book Dependence. pp 40, 41.

a- Ordinary school methods influence. p 40

b- Habit of leaning on authority. p 40

c- The boy who could see only one coat on a seed. p 41.

8- Use of Outlines. pp 41-44.

a- Plan of work is necessary but must be flexible. p 42.

b- "Series of suggested possibilities rather than of rigid prescriptions." p 42.

c- "No outline is altogether good except one that is made with special reference to the particular teacher and to the neighborhood of the particular school."

d- Danger of following a home constructed outline too rigidly. p 43.

e- The worst phase of the outline danger. p 44.

9- Hopeful Outlook. pp 44-45.

a- "A thoroughly good course in nature study, one that includes all the advantages and avoids all the dangers, is a thing of slow construction; and perhaps it is impossible of construction as yet. It is not a question only of what material is available, it is a question also of what material has valuable significance and of what appeals to children."

VI- Summary of Educative Results of Nature Study.

A- Coulter and Patterson. pp 25-38.

1- A Sustained Interest in Natural objects and the phenomena of nature. p 26.

2- Independence in observation and inference. p 26.

3- Some conception of what an exact statement is. p 27.

4- Some conception of what constitutes proof. p 27.

B- Bailey. pp 50-57.

1- Its legitimate result is? p 50

2- Gives relaxation from formal school work. p 51.

3- Develops personality and encourages thinking. p 52.

4- Tends toward simplicity of living.

5- Puts new force and enthusiasm into the school and the child. p52

6- Nature study spirit stands for a normal outlook on life. p 53.

7- Sets our thinking in the direction of our daily doing. p 54.

8- Brings the child into natural relations with the world. p 54.

9- Nature study teaching to utilize as a means of education the tools a boy or girl naturally uses. p 55.

10- Observations on self has a remarkable significance to health. p 55.

a- "The application of the nature study spirit of direct and simple observation of ourselves, with less of the physician's physiology, would benefit the pupil and also our civilization immeasurably." p 56.

11- The public and social value of nature study. p 57.

VII- Nature Study and Agriculture.

A- Comstock pp 21,22.

1- Agriculture cannot be worked out by rules because nature varies. p 21.

2- Nature study and agriculture based upon the study of life and physical conditions which encourage or limit life. p 21.

3- Nature furnishes materials and laboratories on every farm. p 21

4- Child in nature study makes progress by understanding laws of life. p 21.

5-Child in nature study learns

a- How a plant grows;

b- Adaptation of roots;

c- Work of the leaves;

d- How flowers are pollinated;

e- How seeds are scattered and planted. p 21.

6- Nature study related to science and has practical lessons for the future farmer. p 21.

7- "Why not nature study along lines of agriculture solely?" p 21.

8- Why not provide recreation for a boy in hoeing corn rather than in playing ball? p 21.

9- Reason for selecting wild flowers for beginning nature study of plants. p 22.

10- Interests of farmers along what lines. p 22.

11- Why necessary for the farmer to have a wide knowledge of plants and animals. p 22.

12- Elements that make the ideal farmer. p 22.

13- How may a farmer have a true appreciation of his farm? p 22.

14- "Nature Study is the alphabet of Agriculture and no word in that great vocation may be spelled without it." p 22..

B- Bailey pp 93-110.

1- Difference between education for culture and education for sympathy for one's environment. p 94.

2- Agriculture as a livelihood or the expression of the essential relationship of man to his planet home. p 95.

3- The primary educational course for the development of the race. p 95.

4- What constitutes effective living in the open country? p 96.

5- Specific agricultural phases of environment need a foundation and a base. p 97.

6- Nature study agriculture to be approached from an occupational point of view or from the educational and spiritual. p 98.

7- "All agricultural subjects must be taught by the nature-study method, which is; to see accurately; to reason correctly, from what is seen; to establish a bond of sympathy with the object or phenomenon that is studied." p 100.

8- Need of a laboratory of living things. p 101.

9- Three steps necessary to introduce agriculture into any elementary rural school. p 102.

10- Means for creating sentiment for agricultural work in schools. p 104.

11- "Appeal to greater efficiency of the farm alone cannot permanently relieve the agricultural status. pp 105-106.

12- Common Schools to be based on the fundamental idea of serving the people in the very lives the people are to lead. p 107.

13- How the beginnings of the new order are seen. p 107.

14- Need of coordinate efforts outside the schools. p 109.

C- Coulter and Patterson. pp 1-4.

1- "It makes no difference whether we call it elementary agriculture or agricultural nature study; it is the same thing and should be so

understood. It is the study of plants and animals, of soils and weather, of natural forces and phenomena, of the interrelations and interdependence of natural objects. of the relation of all these to man, and of man's power in controlling them and making them work for his good." p 1.

2- Nature study and elementary agriculture not antagonistic. ppl,2

3- How nature study and elementary agriculture may not be justified in a system of schools which aims to turn out a higher type of man as well as a higher type of farmer. p 2.

4- How the elements of agriculture in the seventh and eighth grades may fail of greatest success. p 2.

5- Children rather than the subject must be given the first consideration. p 3.

6- Problems must appeal to children not necessarily to adult farmers. p 3.

7- Study of real objects; not a study about objects. Also doing things. p 3.

8- Value of nature study work- the prevocational in the first six grades is two-fold:- p 3.

a- "The pupils gain a fund of useful knowledge as a foundation upon which to build the 'practical work' ".

b- "They come to it with live interest and broadening minds."

9- "We do not want our country boys to become merely efficient farmers who have learned to do certain things that they may make more dollars. We want them to be men who realize the larger applications of the laws and

principles they are following, men who see and discriminate, who grasp situations, who think for themselves, and who have an abiding interest and enthusiasm for their profession, looking upon their fields, orchards, and meadows somewhat as laboratories in which to work out experiments to the end that they may do their work more profitably and enjoyably. We would have them men who take a keen pleasure not only in making their soil more productive, and in raising better crops and stock, but quite as much in making the home and its surroundings and the life within it more comfortable, more interesting and more beautiful. In so far as nature study does not contribute directly to these ends it is not justified, but if it does contribute to them, who shall say 'it is not sufficiently related to life?' p 4.

Finding Time for Teaching Nature Study.

Doubtless there are many teachers who will concede that a study of the child's environment is highly educative. But their excuse for not making a start is that the daily program is already overcrowded and there is not now really enough time for the conventional subjects. It is surprising, however, how much difference there is between teachers of adjoining school districts or even in the same school building with reference to finding time for many things. There is time enough in this world to do the things that ought to be done. The question is, "What are the most important things to be done?"

Two ways are now being used to find time for nature study and Agriculture viz; Elimination and Combination of Classes or group instruction.

I- Elimination.

Makers of Courses of Study are dropping overboard <u>useless</u> material and substituting <u>useful</u> material to secure the desired ends in the training of

the child.

A- Course of Study and Syllabus for Elementary Schools of New York, 1910.

1- Geography:- "A considerable amount of the subject-matter that frequently appears in geography courses has been dropped from this course because it was not considered vital or fundamental." p 42.

2- Physiology:- "Technical terms and topics not essential to the cultivation of health and strength should be omitted." p 114.

3- Grammar:- "The following may be well omitted from the elementary course in grammar;

a- Subdivisions of adverbial clauses;

b- More difficult uses of the nominative and objective cases;

c- More difficult uses of infinitives and participles;

d- Analysis of complicated sentences;

e- Parsing of words in unused constructions.". p 166.

4- Arithmetic:- "If arithmetic is to be given in both the seventh and eighth years it will be possible to insure greater efficiency along industrial and commercial lines through reviewing, drilling on, emphasizing and enlarging upon those processes and applications which are considered essential." p 168.

B- Elementary Course of Study for the Common Schools of Wisconsin,1913

1- Geography:- "Only the elements of so-called mathematical geography should be taught. This should be done largely by means of oral lessons presented by the teacher." p 208.

2- Grammar:- "No attempt should be made to cover all the minute details of the subject usually given in text books on English grammar. Involved and equivocal questions should be omitted entirely from the study." p 84.

3- Arithmetic:- "Much of the old time arithmetic is obsolete and should be omitted; as Alligation, Averaging Accounts, Partnership, Duodecimals, etc. Many portions are too technical or too difficult for the student below the high school. Omit in percentage, bank discount, stocks, and bonds, partial payments, taxes; in denominate numbers, all obsolete tables and Troy weight, apothecary weights, long ton, surveyor's measure, circular measure and all or nearly all problems with more than two denominations, for they probably would never occur in business; omit greatest common divisor; in fractions omit problems with denominators with 3 orders, and many of the more complicated complex fractions." p 176.

C- State Course of Study for the Elementary Schools of Washington,1915.

1- Grammar:- "No attempt should be made to analyze difficult sentences. Very little attention should be given to a study of conjugation of the Verb." p 44.

D- Course of Study for the Public Schools of Idaho, 1913.

1- History:- "The subject of wars and battles should not be enlarged upon beyond what is necessary for an understanding of the movement of history." p 100.

2- Arithmetic:- "Omit from teaching arithmetic the following:----- Compound proportion; true discount; most problems in compound interest; problems in partial payments, except those of a very simple kind; the same for

commission and brokerage; for example, all problems involving fractions of shares; profit and loss as a special topic; equation of payments- made unnecessary by improved banking facilities; partnership-made unnecessary in the old sense, by stock companies; cube root." p 80.

II- Group Instruction.

A- Montana State Course of Study, 1914.

1- Grade work not essential:- "To divide a one-room school into eight grades for agriculture would be inexpedient. The whole school may work upon material of the same kind at once, or at most two grades may be made. The unlimited variety of seeds and plants and animal forms makes it possible to vary the work sufficiently from season to season. Grades may be more generally recognized in correlating agriculture with other subjects." p 171.

B- Elementary Course of Study for the Common Schools of Wisconsin,1913.

1- "The principal idea of the course is to grade the work of each pupil to a proportionate advance in each of the branches composing a Form; the subordinate idea is to grade the school into three sections, each representing but one form. In otherwords a "Form" is a body of related work, and is not a group of pupils. It is not the purpose of this gradation to regulate one pupil's progress by that of another, but to require each pupil to make equal progress in all the branches. The course shows how much geography or language a boy should know when he has acquired a certain knowl ge of arithmetic.------- In a one-room country school it is out of the question to have eight groups of pupils." p 14.

2- "Agriculture is a subject that should be studied throughout the entire school year. In order to economize classes, teachers should alternate the class in agriculture with classes in physiology and civics." p 234.

C- Course of Study for the Common Schools of Illinois, Fifth General Revision, 1912.

1- Alternation:- "Alternation is the systematic and regular union of two grades of pupils on consecutive years of work, both grades doing the work of one year in one class while the other year's work is entirely omitted. The next year, the work omitted is taken up and the first year's work dropped. By this plan, each pupil does all the work in the course, but not in the same order, while the number of classes is greatly diminished." p 8.

2- Organization of Classes.

a- "In September of even numbered years, 1912,1914, 1916, etc., organize First year in everything; Second year in reading, spelling and number; Third year in everything; Fourth year in arithmetic; Fifth year in everything; Seventh year in everything; Eighth year in grammar."

b- "In September of odd numbered years, 1913, 1915, 1917, etc., organize First year readihg, spelling and number; Second year in everything; Third year arithmetic; Fourth year in everything; Sixth year in everything; Seventh year grammar; Eighth year in everything." p 9.

Nature Study as a Regular Study on the Daily Program.

I- The Making of the Daily Program.

1- The factors entering into the construction of a daily program come in the Writer's course in Rural School Administration and consequently will not be considered here. A country school teacher has to do three things, viz:- Organize the school, Manage it and Teach. She should receive help from some where as to how to classify and make a program to avoid multiplicity of classes and economize time.

2- California has not a State Course of Study, though it has state uniformity of text-books, a fact that, seemingly, would make it very easy and desirable to have one standard for the entire state rather than 58 standards, one for each county. An examination by the writer of the manuals, outlines, etc., of 44 counties of the 58 shows only four counties print a suggestive daily program for the rural teacher.

II- Daily Program of Ventura County, California.

A- Course of Study adopted by the Board of Education, Ventura County, California, June 1915.

1- Alternation:- "The plan of alternation increases the number of pupils in the class and makes the work more interesting to them. Each pupil will do better work, because each is anxious that his work shall compare favorably with that of the other members of his class. Some object to the plan of alternation because it puts children of different ages and different degrees of development in the same class. In many cases, this is a benefit, rather than an injury. The younger pupils get a wider view of the subject by being in a class with older ones. Altho their work may not be characterized by the same maturity as that of the older ones, they get the essential things in the lessons and gain inspiration by the better

work of their leaders. The assistance that the older pupils give the younger ones in the recitation helps to make the subject clearer to them. The plan of alternation has been thoroughly tested. It has been used in thousands of schools in all parts of Illinois, and there is no doubt that the plan is entirely practical." pp 5,6.

2- Daily Program Ventura County:- "Following is a suggestive program for a one-teacher school for the year 1913-14. Using the plan of alternation, it eliminates the third, fifth and seventh grades in all studies but arithmetic and thereby secures recitations of fifteen minutes in length. In most cases a study period is provided for before the recitation, and another after the recitation. The purpose of the latter is to enable the pupil to fix in the mind the explanations that have been made in the class. It is believed that this is a valuable feature." pp 7,8.

Daily Program of Recitation, Rural School Ventura County, 1913-14.

Forenoon.			Afternoon.		
9:00-	All-	Opening Exercises.	1:00-	6,8-	Literature.
9:10-	1 -	Primary Work.	1:15-	1 -	Primary Work.
9:25-	2 -	Numbers.	1:30-	2 -	Reading.
9:40-	3,4,5-	Arithmetic.	1:45-	8-	Gram. or Composition.
9:55-	4,5-	Arithmetic.	2:00-	4-	Reading.
10:10-	7,8-	Arithmetic.	2:15-	6-	Reading or History.
10:25-	6-	Arithmetic.	2:30-	4-	Geography.
10:40-		Recess.	2:40-		Recess.
11:00-	8-	Geography.	3:00-	6-	Geography.
11:15-	1,2,4-	Spelling.	3:15-	8-	History.
11:30-	6,8-	Spelling.	3:30-	6-	Grammar or Composition.
11:45-	1,2,4-	Writing.	3:45-	6,8-	Writing.
12;00-		Noon.	4:00-		Dismissal.

III- Daily Recitation Program, One teacher Country School, Illinois.

1- Daily Program to be used. in September of even numbered years, 1912, 1914, 1916, etc.,

Begin	Time	Year	Recitation
9:00	10	All	Opening Exercises.
9:10	10	1	Primary Work
9:20	10	2	Number
9:30	10	3	Arithmetic
9:40	15	7	Arithmetic
9:55	10	4	Arithmetic
10:05	10	5	Arithmetic
10:15	15	7	Reading
10:30	15	All	Recess
10:45	10	1	Primary Work
10:55	10	2	Spelling
11:05	15	5	Reading
11:20	20	7-8	Grammar
11:40	10	3	Spelling
11:50	10	7	Spelling
12;00	60	All	Noon
1:00	10	All	Opening Exercises
1:10	10	1	Primary Work
1:20	10	2	Reading
1:30	10	3	Reading
1:40	15	5	Geography
1:55	15	All	Writing & Drawing
2:10	10	7	Geography
2:20	10	5	Spelling
2;30	15	All	Recess
2:45	15	1-2	Lang. & Nat. Study
3:00	15	7	Hist & Civics
3:15	15	3	Lang & Nat. Study
3:30	15	5	Lang. & Nat. Study
3:45	15	7	Physiology 4 mos. and Agriculture 4 mos.
4:00			Dismissal

2- Daily Program to be used in September of odd numbered years, 1913, 1915, 1917, etc.

Begin	Time	Year	Recitation.
9:00	10	All	Opening Exercise
9:10	10	1	Primary Work
9:20	10	2	Number.
9:30	10	3	Arithmetic
9:40	15	8	Arithmetic
9:55	10	4	Arithmetic
10;05	10	6	Arithmetic
10:15	15	8	Reading.
10:30	15	All	Recess
10:45	10	1	Primary Work
10:55	10	2	Spelling.
11:05	15	6	Reading
11:20	20	7-8	Grammar
11:40	10	4	Spelling
11;50	10	6-8	Spelling
12:00	60	All	Noon
1:00	10	All	Opening Exercise.
1:10	10	1	Primary Work
1:20	10	2	Reading
1:30	10	4	Reading
1:40	15	6	History
1:55	15	All	Writing & Draw.
2:10	10	8	Geography
2:20	10	4	Geography
2:30	15	All	Recess
2:45	15	1-2	Lang & Nat.Study
3:00	15	8	Hist. & Civics
3:15	10	6	Lang & Nat.Stud
3:25	10	4	Lang & Nat.Stu
3:35	15	8	Physiology 4 m
3:50	10	6	Geography/Ag."
4:00			Dismissal

Note 1- For years one to six, the nature-study work includes phydiology hence it is not necessary to arrange a special class in physiology in any of these years, and no separate place is provided on the suggested programs.

Note 2- Since some of the materials for the language work in each of the grades one to six may well be drawn from the nature study work, it is suggested that the recitations in these subjects be alternated. On Monday, Wednesday and Friday of each week teach the work outlined in this course under language; and on Tuesday and Thursday of each week, at the same time that language is taught on other days, teach the work outlined under Nature Study.

Note 3- Physiology work in seventh and eighth grades continues but four months. This gives an opportunity for four months of elementary agriculture in those two years. If desired physiology can run three times per week for 8 months and agriculture two times per week for 8 months or agriculture can run three times per week for 8 months and physiology two times per week for 8 months. This arrangement seems more desirable than to have agriculture three times per week during general exercises in the afternoon alternating with Morals and Manners twice per week. If any teacher desires this latter arrangement, then the four months of the year when physiology is finished may be given to History, Civics, or Grammar-- that is the 10 or 15 minutes daily extra time can be given to those subjects. In the above program time is found two periods a week for entire school year for Nature Study and elementary agriculture. This is a beginning. These subjects should have a definite place on the program as do reading, arithmetic, etc. The Illinois Course of Study has been in use since September 1889. It has had Five General Revisions since that time.

IV- Making Time or Marking Time on the Daily Program.

1- Wasting Time:- Just how far the efficiency engineer may eliminate

waste in the country school is a matter for discussion. Just how far the methods of the manufacturing efficiency expert may apply to the school room is a matter for more discussion. One may figure out to a mathematical nicety the exact "units of efficiency" in a workman who occupies so many cubic feet of space; handles so many square feet of raw material; drills so many holes; turns out so much finished product, worth so many dollars f.o.b; and who punches a bell coming and going. Whether the educational expert from the psychological laboratory can determine the value of school work from units of space occupied; character of the living raw material; quality of contact of life with life; and weigh out the finished product in terms of ambition, inspiration, life purpose, service, etc., is a matter of conjecture for no one has tried it.

2- Wasting Time in English:- During the writer's fifteen years of rural school administration it seemed to him that much time was wasted during the eight years of school room work in English. This will provoke a smile on the part of the university professor who is quite sure that no high school teacher knows how to teach English judging by the attainments of high school graduates. It will provoke riotous mirth on the part of the high school teacher who receives the graduates from the grades. The grade teacher is quite sure the home is to blame for the poor language and tells the mother so. The mother is quite sure the children reveal an inherited characteristic from the father some branch of whose family was quite illitera The father's energies are wholly taken up to provide for the family and he rather expects the school to do something to remedy the defects of heredity and environment. One is tempted to sympathize with the father's attitude

and so they survey ends.

3- Text-book Assignments in Language:- For grades one and two in a rural school no text book will be required of course. The instruction is oral. The teacher may have a manual on primary language work and State Courses of Study outline the material, some more in detail than others, for these two grades. It will be found that conversational lessons on nature study material afford good language drill. For grades three, four, five, six, seven, eight a two book course in "Lessons in English" or "Elementary Language and Grammar" are adopted for use in the schools. The writer has examined many "two book" texts in elementary English and each book averages about 300 pages, making a total of 600 pages of printed text to be mastered by the pupil in the six years above the two primary grades, thus averaging 100 pages of text in a single school year.

4- Division of Time between Language and Nature Study: As was stated above there are on an average 100 pages of text for each year of a country school above the second grade. There are 8 months school of 20 days to the month making a total of 160 recitations in language for 100 pages of text book per year. It would seem that there is plenty of time to get good results. It may be that much of the material given in the average text book does not appeal to both teacher and pupil. Nature study may furnish very interesting subjects for oral and written expression. Then by giving three periods weekly to language and two periods weekly to nature study there will still be time enough to cover the text. For three-fifths of 160 recitations gives 96 recitations in language during a year for 100 pages of text and two-fifths of 160 recitations gives 64 recitations in nature study during the

same year for the same grade. This division of time only for the third, fourth, fifth and sixth grades. The seventh and eighth grades can give full time to their grammar and composition. Time for elementary agriculture for these two grades has been indicated above.

5- Summary:- By any test of efficiency or fancied necessity it is hard to justify the formation, in a one-teacher school of eight different classes, one for each grade, with eight daily recitations in English. Four language recitations daily should be the maximum. The first two grades can be combined into one recitation period; the third and fourth into a second period; the fifth and sixth into a third period; and the seventh and eighth into a fourth period. Indeed the time will come in the better organization and administration of a rural school when only three separate groups are necessary to give the proper instruction in some of the subjects. In the above arrangement the four groups can be reduced to three. The primary will be composed of grades one and two; the intermediate of grades three, four and five; and the advanced pupils of grades six, seven and eight. There are teachers who are getting excellent results in agricultural nature study by such grouping. In the country school there may be more freedom than in a standardized city system. It is the writer's firm conviction that we are marking time and wasting time in elementary language work for the results we are getting. Nature study and agriculture furnishes the material to vitalize the language work in the rural school. In book one of a two-book course in "New English Lessons" there is a picture for composition work. It represents a nicely furnished room with a nicely dressed little girl seated on a rug. Over her is an umbrella on which a nicely dressed little boy is

pouring water, presumably from a cut glass water bottle. Imagine a real live country boy getting an inspiration for better language work by writing on "A Shower in the Drawing Room." Why not furnish him the motive to write about "A Shower in the Open Country" which is a real rain-fall and benefits crops and people?

V- Daily Program of Recitations for Country School in Wisconsin.

Begin	Time	Subject	Class	Principal Source of material.	Character of work Sections of Manual
9:00	10	Opening Exercises	All		624.
9:10	15	Reading	A.	Classics	66
9:25	15	Reading	D.	Second Reader	36, 44, 73, 74.
9:40	10	Reading & Lang.	F.	Beginners	13, 72.
9:50	15	Reading	E.	First Reader	13, 36, 72, 73.
10:05	15	Reading	C.	Third Reader	44, 51, 58.
10:20	15	Reading	B.	Fourth Reader	58, 62.
10:35	15	Recess			p XII
10:50	15	Arithmetic	A.	Advanced text book	Upper form
11:05	10	Arithmetic	D.	No text-Oral work	193, 194, 195.
11:15	10	Reading & Lang	F.	Beginners	13, 193
11:25	15	Arithmetic	B.	Elementary text book	220, 221.
11:40	10	Arithmetic	C.	Ele. text (optional)	195, 219.
11:50	10	Spelling	B.	Text book	76, 77.
12;00		Noon			
1:00	5	General Exercises			
1:05	15	Language	A.	Advanced text	122-126.
1:20	15	Language	D.	Oral Work	103-112, 307-315. 376-383.
1:35	10	Lang. and Reading	F.	Beginners	104-315, 376, 381-383, 443.
1:45	15	Language	C.	Oral work	113-118, 307-319, 376-388, 443-447.
2:00	15	Language	B.	Elementary text (optional)	116-121, 376-388, 443-448, 567-573.
2:15	15	Writing	All		165-176.
2:30	15	Recess			
2:45	15	Geog. ½ year Hist. ½ year.	A.	Advanced text	296, 297, 298 330, 518-537-566
3:00	10	Reading	E.	First Reader	13 & 36, 72, 73.

Begin	Time	Subject	Class	Principal Source of material.	Character of work Sections of Manual.
3:10	10	Reading	D.	Second Reader	36, 44, 73, 74.
3:20	15	Hygiene ½ year Civics ½ year Agr. 1 period per week all year.	A.	Text Book Library books	449, 574, 575, 576 579, 395-434.
3:35	15	Hist. ½ year Geog. ½ year	B.	Elementary Text	481-501, 502-512 305, 306.
3:50	10	Spelling	A.	Text book	78.
4:00		Dismissal.			

See Elementary Course of Study for Common Schools of Wisconsin, 1913, page342.

VI. Daily Program of Recitations for One Room Schools of Idaho.

Forenoon.

Begin	Time	
9:00	10	Music (4) Morals (1)
9:10	25	7 and 8 Arithmetic
9:35	10	1 Reading
9:45	10	2 Reading
9:55	15	3 and 4 Read & Lit.
10:10	20	5 and 6 Arithmetic
10:30	10	Recess.
10:40	25	7 and 8 Literature, C. E.
11:05	15	1 and 2 Num.(3) Lang.(2)
11:20	20	3 and 4 Arithmetic
11:40	20	5 and 6 Read, Lit, C. E.

Afternoon.

Begin	Time	
1:00	10	Music (1) Current events (2) Experiments in Science (2)
1:10	15	7 and 8 Grammar
1:25	10	1 Reading
1:35	10	2 Reading
1:45	15	5 and 6 Geography
2:00	15	3 and 4 Geography
2:15	15	7 and 8 Geography
2:30	10	5 and 6 Language
2:40	10	Recess
2:50	10	3 and 4 Language
3:00	10	All Writing(3) Draw (2)
3:10	20	5 and 6 Hist.(3) Phys. (2)
3:30	15	7 and 8 Hist (3) Phys (2)
3:45	15	All Spelling.
4:00		Dismissal.

Nature Study 6 days each month.

See Course of Study for Public Schools of Idaho, 1913, page 22.

VII- Daily Program of Recitations for One Room Schools of Washington.

Forenoon		Afternoon	
9:00	All Music	1:00	All Opening
9:15	1 & 2 Reading	1:05	7 & 8 History
9:30	7 &n8 Reading	1:20	1 & 2 Reading
9:50	3 & 4 Reading	1:35	3 & 4 Reading
10:10	All Writing	1:50	5 & 6 English
10:25	Recess	2:05	7 & 8 English
10:35	1 & 2 Numbers	2:20	3 & 4 English
10:50	5 & 6 Reading	2:35	Recess
11:10	7 & 8 Arithmetic	2:45	1 & 2 Language & Spelling
11:25	3 & 4 Arithmetic	2:55	5 & 6 Science
11:45	5 & 6 Arithmetic	3:10	7 & 8 Science
12:00	Noon	3:25	3 & 4 Science
		3:40	5 & 6 History
		3:50	All Spelling
		4:00	Dismissal

See State Course of Study Elementary Schools of the State of Washington,1915 page 5.

Materials for a Course of Instruction in Nature Study.

I- The Immediate Environment of the Child.

A- Extracts from an Address by Dr. W. C. Bagley, Dean of the School of Education, University of Illinois. "In brief the 'nature study idea" in teaching is simply a plan to utilize the objects and forces of the immediate environment as centers about which to gather and crystalize the knowledge that the human race has accumulated. As its advocates so strenuously insist, nature study is a study of things rather than of words,-- a study of the real objects that surround us, rather than of what men have said about these things. Sometimes this point of view has been a little disconserting to the teacher, who has perhaps come to think of knowledge as essentially something concerned with books. But this attitude is due to misapprehension.

A type of education that divorced itself entirely from the printed page would of course, be not only short-sighted but fatal. What man has found out about the materials with which he is brought in contact,- what they are composed of, where they come from, how they grow or how they are produced, how he recognizes them when he sees them, and most important of all, how he can use them for his own purposes,-- these are the topics with which books deal and to cast books aside would be to cut ourselves loose from that great store of human experience which forms the basis of our interpretation of the world.---------- "But if the nature study idea does not propose to divorce education from books, in what way does it differ from the type of education with which we are all familiar. It seems to me that the chief difference is in the approach to teaching. Our methods of instruction have been prone to plunge the child at once into the deep sea of words without first taking the precaution to teach him to swim. And the nature study idea proposes first to teach him to swim by suitable exercises in shallow water. We shall begin with what the child knows best and is most interested in,and these are the things that immediately surround him. Through these we may stimulate in him a desire to know and appreciate and understand these things in the light of what the race has discovered about them. And this is the way all knowledge has grown. It has started with human interests and human needs, and it has been in satisfying these interests and meeting these needs that knowledge has developed. And so the thing has come first and the word later,--the interest and the need, and then the book,-- and this is the sequence that the nature study idea would introduce into the work of teaching.

The great difficulty about employing this natural method of approach in teaching lies in the fact that we who teach have obtained our knowledge

chiefly in another way. It has been more or less divorced from the realities of life. We have been led to think of the printed word as one thing and the world of men and objects as quite another thing. "We have missed that intimate connection which I have attempted to trace, and the fact that knowledge must always justify itself in helping us to understand and use the things of everyday life has seldom been forced upon us. As a consequence we find it extremely difficult to make this connection in our teaching.

"It was this difficulty which led to the development of the Course in Agricultural Nature Study. This course outlines a plan of using systematically the materials of the child's own environment for the purpose of bringing him into possession of his heritage of knowledge. It suggests the materials that can be effectively used in each grade during every month of the year. And inasmuch as the course is intended primarily for the rural schools, it emphasizes, slightly at first, and then with a gradually increasing insistence, the vocational factor."

"The nature-study idea as applied to agriculture means in the first place, then, that the materials of instruction be confined at the outset to the materials found in the immediate environment of the child. But it also means something more. It means that the study throughout is to emphasize the child's own activities in observing and studying these materials in collecting data for himself, and in drawing for himself certain inferences and conclusions. A great many of the facts that are important in life can be learned by anyone who keeps his eyes open. Many of them it is true remained undiscovered for a long time, but this was largely because men's prejudices prevented them from seeing what was right before their eyes.

It is not difficult to demonstrate the curvature of the earth, for example, but for centuries men refused to think of the earth as round, because their minds were held in bondage by certain superstitions which blinded them to the truth. For a period covering one thousand years, men persistently refused to study the natural objects about them. If a question was raised with regard to trees, the learned men went to the books and found out what Aristotle had to say about them. Aristotle was a great man,-- undoubtedly the greatest man from the standpoint of intellect that the human race has yet produced. But no man even though he be an Aristotle, has a right to do the constructive thinking for the entire world over a period of ten centuries.

"I quite agree with those who voice the criticism that our schools are encouraging superficial rather than penetrating knowledge, but I cannot see that this is an inevitable outcome of the present plan. If the teacher is careful to keep returning to a topic until it has been thoroughly mastered, and careful also to spend generously of the time alloted for this work in thorough going reviews that will make out of the facts gleaned a coherent and well-articulated body of knowledge, this grave danger will in a measure, be counteracted. Let me suggest that it will not be essential to success with this course to cover every topic that is outlined. Far better an intensive study of a few topics than a scattered and ill-digested survey of the entire field. I do not think that the seasonal arrangement of topics means that the teacher should never refer to them after the season in question has passed. The seasonal arrangement simply means that we should take advantage of the dominant activities and interests in introducing new material. But once we have made our initial study, we should not be afraid to review and

and drill until our facts are well mastered. I feel like emphasizing this statement very strongly. One of the chief weaknesses of the nature-study movement has been its unholy alliance with a certain type of "soft Pedagogy" which asserts that the child should never do anything in which he has not an immediate interest. The valuable features of the nature-study idea can be retained without surrendering ourselves to this fatal fallacy. If we have done our best to give our teaching a vital setting, and to relate it to the life and activities of the child, we must hold the child responsible for doing his share, and this will involve concentrated effort and frequent repetitions until mastery results. If what we teach is worth while, it will necessarily involve effort and concentration in its mastery; and the only reason in the world for providing an attractive approach to our problems is to stimulate our pupils to put forth their very best efforts."

II- The Nature of the Child.

A- Coulter and Patterson, Practical Nature Study and Elementary Agriculture. pp 75-81.

1- How does the child's world differ from that of the adult? p 75.

2- What desirable qualities may boys and girls acquire through the right teaching of nature study? p 76.

3- What characteristics do children have in common? p 76

4- Characteristics of children of Primary Grades. pp 76-78.

a- Interested in what?

b- Ideas how gained and fixed?;

c- Duration of interests in activities and objects;

d- The time element in their lives.

e- Present stock of knowledge how gained?

f- What do they know?

5- How prevent the formation of the gap between home and school? page 77.

6- Materials for Nature Study Course in Primary Grades. p 77.

a- What food materials?

b- What animal and plant life?

c- Shelter and Clothing.

d- How utilize the activities of the children?

7- Characteristics of Children of Intermediate Grades. pp 78-79.

a- How are new relations established between them and their environment?

b- What new interests belong to the children of these grades?

c- Character of the creative instinct?

d- What new desires have they?

e- What must be the general character of the tasks assigned them at this age?

8- Materials for Nature Study Course in Intermediate Grades. p 78.

a- Plant life where found?

b- Animal life what?

c- Natural phenomena and tools.

d- Appropriate material affords what two opportunities to children of these grades?

e-Value and importance of developing responsibility.

9- Characteristics of Children of Grammar Grades. p 79.

a- Experiences and knowledge.

b- Laws and living things.

c- Attitude towards natural processes.

d- Searching for truth.

e- Recognition of social order and need of cooperation.

10- Materials in Nature Study Course for Grammar Grades. p 79.

a- Enjoyment in what kind of work?

b- Kinds of experiments.

c- Fundamental relations.

d- Original designs.

e- Group Classifications

11- Opportunity for progressive work. p 80.

12- Adaptability to the child always first consideration in choice of material and method of presentation. p 80.

13- Importance of natural relations. p 80.

14- Illustration of organization of material. p 80.

15- Fitting the nature work to the needs of the child; "While the hope of fitting the nature work to the exact needs of the child at every step in his development will, perhaps never be fully realized, yet, if the work is planned and carried out along lines of his growing intelligence and sympathies, it will fulfill its mission. It will leave the child better equipped to meet the exigencies of life, better disciplined, physically,

mentally, and morally to do work in the world, and it will leave an abiding interest in nature which stimulates self-resourcefulness, and makes the world in every aspect always a most interesting and enjoyable place of residence." pp 80,81

Some Principles of Teaching in a Course of Instruction in Nature Study.

There is great need of care in the use of terms that children can understand. Contrast the language used in the following, both describing the manufacture of starch and change to sugar in plant growth.

1- For university students in Atkinson's College Botany pp 67 and 77; "We reason from this that starch is the product of chemical change which takes place in the green cells under these conditions. The carbon-dioxide which is absorbed by plant mixes with the water in the cell and immediately forms carbonic acid. The chlorophyl in the leaf absorbs radiant energy from the sun which splits up the carbonic acid, and its elements then are put together into a more complex compound, starch. This process of putting together the elements of an organic compound is a synthesis, or a synthetic assimilation, since it is done by the living plant. It is therefore a synthetic assimilation of carbon-dioxide. Since the sunlight supplies the energy it is also called photosynthesis, or photosynthetic assimilation."

"We have seen that in many plants the carbohydrate formed as the result of carbon-dioxide assimilation is stored as starch. This substance being insoluble in water must be changed to sugar, which is soluble, before it can be used as food or transported to other parts of the plant. This is accomplished through the action of certain enzymes, principally diastase. This

substance has the power of acting upon starch under proper conditions of temperature and moisture, causing it to take up the elements of water, and so to become sugar."

2- "Uncle John's" story of the starch factory in a Cornell Nature Study Leaflet for the boys and girls of New York state: "Plants are just like us; they have to have food to make them grow; where is the food and how do they get it? Every green leaf is a factory to make food for the plant; the green pulp in the leaf is the machinery; the leaves get the raw materials from the sap and the air, and the machinery unites them and makes them into plant food. This is mostly starch, for this is the chief food of plants, although they require some other kinds of food also. The machinery is run by sunshine power so the leaf-factory can make nothing without the aid of light; the leaf-factories begin to work as soon as the sun rises, and only stop working when it sets. But the starch has to be changed to sugar before the baby growing tips of the plant can use it for nourishment and growth; and so the leaves after making the starch, are obliged to digest it, changing the starch to sugar for the growing parts of the plant feed upon sweet sap. Although the starch factory in the leaves can work only during the daytime, the leaves can change the starch to sugar during the night. So far as we know, there is no starch in the whole world which is not made in the leaf factories."

A- White Elements of Pedagogy.

I- "Principle 1:- Teaching, both in matter and method, must be adapted to the capability of the taught". p 100.

II- "Principle 2:- There is a natural order in which the powers of the mind should be exercised, and the corresponding kinds of knowledge taught."

page 104.

"This principle has been specialized in the form of maxims of elementary teaching, including the following:

1- Observation before reasoning.

2- The concrete before the abstract; sense knowledge before thought knowledge.

3- Facts before definitions or principles.

4- Processes before rules.

5- From the particular to the general.

6- From the simple to the complex.

7- From the known to the related unknown

There are limitations to above maxims.- p 105.

III- "Principle 4:- Knowledge can be taught only by occasioning the appropriate activity of the learner's mind." p 111.

IV- "Principle 5:- The primary concepts and ideas in every branch of knowledge must be taught objectively in all grades of the school." p 113.

B- McMurry, The Method of the Recitation.

I- Laws Underlying Processes in Teaching:- "If the leading thoughts thus far presented are true, there are certain steps in instruction that are universal. No matter what the study be, whether Latin, mathematics, science, or some other, there is a certain order that the mind must follow in acquiring knowledge. Through the old related experiences (first step preparation) new individual notions are reached (second step, presentation); these are compared and their essential characteristics abstracted (third step, comparison), and the resulting general truth is worded (four step, generaliza-

tion); this generalization finally receives application (fifth step, application). Since these steps ,are passed through in this order without reference to the nature of the subject matter presented, they are rightly called the Formal Steps of Instruction." p 288.

II- A Clear Outline of Pivotal Questions:- "Aside from an aim, the teacher will also be greatly aided by a clear outline of pivotal questions. If she realizes what her two or three main problems are for a thirty-minute period, she has practically three or four sub-aims in mind, and they will keep her upon the right road in the subdivisions of the recitation, just as the large aim for the entire period guides her for the whole recitation. A clear statement of the leading questions on a given subject is essential to the fullest preparation for teaching it. Very often good instructors prepare for class work by arranging their subject-matter in topics and designating each by an appropriate heading. But a great amount of indefiniteness may be concealed under mere headings. The division of a subject into topics, with a suitable name for each, can be made by one who possesses no skill whatever as a teacher; but the proper wording of the corresponding questions that would actually be put in class cannot be given by such a person--that requires an intimate knowledge of children's interests, of their vocabulary, etc. This means that the method of treating a subject has not yet been determined when one has decided only upon his topics. Training teachers in the model departments of normal schools receive remarkably little information about the actual method to be employed by student teachers, when the latter present to them only a careful outline of the subject-matter to be taught. The difficulty here involved has been already suggested in the discussion of

the aim of the recitation. In that connection it was stated that the aim might often take the form of a question or problem, and it was shown by example how difficult it was to find a suitable wording for it. But as in the case of the aim, so here, the rightly worded question plants a topic within reach of the children, within their experience and interest. Here we see again how adjustment of the new to the old is secured.

"An example may make the matter clearer. In the study of the sugar maple the chief headings might be shape of tree, root, stem, leaves, etc. Some of the minor ones might be the color and form of the leaves, the density of the shade, the superiority of the hard maple over the soft maple, etc. But with such headings little preparation has been made for actual teaching, for no suggestion is given thus far as to how these matters will be broached in the presence of children. Since these facts cannot best be told to them outright, some question must be conceived which will be broad enough to include several facts and sufficiently suggestive to provoke thought. Let this be one: What reasons can you give why the hard maple, or sugar tree, is so well liked by us all? The replies will come that it is beautiful, the color of the leaves is so green; also, that the shape of the tree is pretty, it is so regular, or symmetrical. Further than that, on hot summer days it gives an excellent shade, denser than that of many trees, for instance, the soft maple. This is partly because the leaves grow on the stems in the middle of the tree, as well as outside where the sun can easily reach them. Also, the tree can endure more than many other trees. The wood is harder than that of the soft maple, hence the name hard maple; and the tree branches differently from the soft maple, so that heavy winds, sleet, etc., are less

likely to break and tear it to pieces.

"If this part of the recitation proves especially interesting and profitable, it is to a great degree because the leading question is broad enough to include several answers under it, and is so stated as to elicit much thinking."

"Further questions might be the following: Where does the tree get its food? What part of the roots acts as mouths for receiving the food? If the little hairs are so important what suggestion would you make about transplanting the trees? Where, then, could the water be best poured for watering trees? Why are these roots and rootlets so knotty and irregular? Where does this water go that enters the roots? Through what part of the trunk does it pass? Why are the leaves so thin and broad? How can the leaves prevent too much evaporation? Why are the petioles of different lengths?"

"The fact that it requires very careful thinking to word such questions as these, even after one is well acquainted with his subject-matter, is proof that they are an important advance upon the arrangement of a subject by mere headings. But the teacher who approaches her class with that preparation, i.e. with her questions clearly marked out, is partly protected from wandering. A proper question requires a definite answer, while both the amount of matter included under a heading and its nature are uncertain. Consequently both teacher and pupil are more likely in the former than in the latter case to know when they are on the right track and when they have finished." pp 147-150

Some Reference Literature in Selecting Outlines for a Course of Instruction in Nature Study.

Chandler- Habits of California Plants.

Essig- Injurious and Beneficial Insects of California.

Payne- California Wild Flowers and Native Trees and Shrubs.

Jepson- Trees of California.

Wheelock- Birds of California.

Parson- Wild Flowers of California.

Jepson- A Flora of Middle Western California.

Wickson- California Garden Flowers, Shrubs, Trees and Vines.

Wickson- California Fruits and How to Grow Them.

Wickson- California Vegetables in Garden and Field.

Monthly Bulletin of California State Commission of Horticulture.

Rogers- Tree Book- Oaks of the Pacific Coast.

Rogers- Among Green Trees.

The Nature Library, 15 vols.- Insects Book, Animals Book, Tree Book, etc.

Comstock- Hand Book of Nature Study for Teachers.

Hodge- Nature Study and Life.

Comstock- Insect Life.

Badenoch- Romance of the Insect World.

Grinnell- Our Western Birds.

Patterson and Dexheimer- Lesson Plans for Teachers in Nature-Study Agriculture.

Coulter and Patterson- Practical Nature Study and Elementary Agriculture.

Bailey- The Nature Study Idea.

Holden- Real Things in Nature.

Cornell Nature Study Leaflets.

Courses of Study, State, City and County.

Some Suggestions on Making an Outline of Courses of Instruction in Nature Study

I- The Fundamental Principle in Selection of Material.

1- See bottom page 9. Review pages 47 and 48 of book referred to on that page.

2- See bottom page 39. Review pages 75-81 of book referred to on that page.

II- Construction of Outlines.

1- "An outline constructed by the teacher is a good thing. It may not be a good outline, but it is the organized expression of the teacher's thought as to the possibility of the subject in that particular school. It is an evidence of independence, which means that the outline will be modified for the better as experience increases. An outline obtained from a successful teacher is also a good thing. It will be a good outline, not to follow, but to study. One may catch from it the principles involved, the spirit, the methods, and the sort of material that has proved successful. It will probably enable another teacher to make his own outline better, but there is always the temptation to 'crib bodily' and be done with the trouble". Coulter and Patterson pp 42,43.

2- Dangers in following outlines. See page 16 and review pages 42,43, 44 of book referred to.

III- Material for Elementary Grades to Furnish Motive for a Maximum of Out-door Activity with a Minimum of Indoor Laboratory Processes.

1- "The best nature-study observation is that which is done out-of-doors;

but some of it can be made from material brought into the school room"- Bailey Nature Study Idea Pages 40,41.

2- "The great intention of nature-study is to cultivate a sensible interest in the out-of-doors, and to remove all conventional obstacles thereto. Real interest in the out-of-doors does not lie in the physical comfort of being in the open in "good" weather (persons who have this outlook do not know nature), but in spiritual insight and sympathy." Bailey, Nature Study Idea. Page 56.

3- "Plants always should be taught by the "laboratory method"; that is, the pupil should work out the subjects directly from the specimens themselves; but I should want it understood that the best "laboratory" may be the field, and that plants are to be studied as plants rather than as dissected pieces." Bailey, Nature Study Idea. P. 70.

4- "In the high school the teacher should be well trained in some special line of science, and if he has had a course in a college of Agriculture he should be much better adapted to the work. Here the teaching may partake more of the indoor laboratory method, although it is possible that our insistence on formal laboratory work in both schools and colleges has been carried too far." Bailey, Nature Study Idea. P. 103.

IV- Selection of Material Suited to California Conditions.

The instructor of this course has asked various members of the staff of instruction of the University of California to give lists of material that will enter into a course of instruction in Agricultural nature study for the rural schools of the State. These lists here follow.

Professor J. W. Gilmore:- Farm Crops Suitable for Study in Schools.

Wheat.

White Australian- A bearded wheat of good milling quality.

Sonora- A beardless wheat of good milling quality.

Club- A beardless compact head wheat, non-shattering and drought resistant.

Barley.

Bay- 6-rowed type for feed.

Hennchen- 2-rowed type for malting.

Hooded- A beardless hooded type.

Oats.

Black- Grows to good advantage along coast.

Red-)Suitable for valleys.
)
Yellow) " " "

Corn.

White dent- (Mexican June).

Yellow dent- (Pride of the North)

Yellow flint.

Sugar.

Pop.

Rye.

Any variety.

Sorghum.

Feterita- An erect white seed variety.

Milo- A yellow gooseneck variety.

Shallu- An open headed variety.

Rice.

Japanese type- Short grain.

Honduras- Long grain.

Potato.

Early rose- Red skin and early.

Burbank- White skin and late.

Beans.

Lima- Pole variety for coast counties.

Pink- For valley conditions.

Tepary- For very dry conditions.

Blackeye- A cowpea for valley conditions.

Sugar Beets.

Any variety.

Cotton.

Durango- Short staple, linted seed.

Egyptian- Long staple, naked seed.

Grass.

Rye- Hay and lawn grass for coast counties.

Timothy- Hay grass for northern and eastern counties.

Bluegrass- For lawns requires much water.

Foxtail- Mostly a weed, beards very stiff when ripe.

Alfalfa.

Any variety.

Vetch. Winter.

Rape. Dwarf essex.

Clover. White.

Red.

Professor E. O. Essig:- Common Injurious and Beneficial Insects Suitable for Study in Rural Schools.

First:- Injurious.

I. Orchards
(Deciduous)

1. Wooly apple aphis (Eriosoma lanigera).
2. Green apple aphis (Aphis pomi).
3. Walnut aphis (Chromaphis juglandicola).
4. European fruit lecanium of brown apricot scale (Lecanium corni).
5. San Jose scale (Aspidiotus perniciosus).
6. Oyster-shell scale (Lepidosaphes ulmi).
7. Pear thrips (Taeniothrips pyri).
8. Lesser shot-hole borer (Xyleborus xylographus).
9. Flat-headed apple tree borer (Chrysobothris femorata).
10. Peach twig borer (Anarsia lineatella).
11. California peach borer (Aegeria opalescens).
12. Spring canker-worm (Paleacrita vernata).
13. Red-humped caterpillar (Schizura concinna).
14. Forest tent caterpillar (Malacosoma disstria).
15. Codlin-moth (Cydia pomonella).
16. Pear or cherry slug (Caliroa cerasi).
(Citrus).
17. Cottony cushion scale (Icerya purchasi).

18. Gray citrus or citricola scale (Coccus citricola).

19. Soft brown scale (Coccus hesperidum).

20. Citrus mealy bug. (Pseudococcus citri)

21. Black scale (Saissetia oleae).

22. Red scale (Chrysomphalus aurantii).

23. Purple scale (Lepidosaphes beckii).

24. Fuller's rose beetle (Pantomorus fulleri).

II. To Grapes and Berries.

25. Grape leaf-hopper (Erythroneura comes).

26. California grape root-worm (Bromius obscurus).

27. Currant or Gooseberry fruit-fly (Epochra canadensis).

28. Strawberry crown moth (Aegeria rutilans).

29. White-lined sphinx (Celerio lineata).

30. Raspberry horn-tail (Hartigia cressoni).

III. To Garden.

31. Green pea aphis (Macrosiphum pisi).

32. Melon aphis. (Aphis gossypii).

33. Squash bug (Anasa tristis).

34. Harlequin cabbage bug (Murgantia histrionica).

35. Bean thrips (Heliothrips fasciatus).

36. Western 12-spotted cucumber bettle (Diabrotica soror).

37. Sugar beet wireworm (Limonius californicus).

38. Potato flea-bettle (Epitrix cucumeris).

39. Western radish maggot (Phorbia planipalpis).

40. Variegated cutworm (Lycophotia margaritosa).

41. Corn ear-worm (Chloridea obsoleta).

42. Potato tuber moth (Phthorimaea operculella).

43. Imported cabbage worm (Pontia rapae).

IV. To Forage Crops and Cereals.

44. Devastating grasshopper (Melanoplus devastator).

45. Oat aphis (Aphis avenae).

46. Tarnished plant-bug (Lygus pratensis).

47. Alfalfa caterpillar (Eurymus eurytheme).

V. To Stored Products.

48. Bean weevil (Acanthoscelides obtectus).

49. Pea weevil (Bruchus pisorum).

50. The granary weevil (Calandra granaria).

51. The rice weevil (Calandra oryzae).

52. Angoumois grain moth (Sitotroga cerealella).

VI. To Flowers and Ornamentals.

53. Rose aphis (Macrosiphum rosae).

54. Green peach aphis (Rhopalosiphum persicae).

55. European elm scale (Gossyparia ulmi).

56. Greedy scale (Aspidiotus camelliae).

57. Ivy or oleander scale (Aspidiotus hederae).

58. Greenhouse white fly (Asterochiton vaporariorum).

59. Rose snout-beetle (Rhynchites bicolor).

60. Mourning cloak butterfly (Euvanessa antiopa).

61. Thistle butterfly (Vanessa cardui).

Second:- Beneficial

I. Attacking Insects.

1. Common red black-spotted ladybird beetle (Hippodamia convergens).

2. The vedalia (Novius cardinalis).

3. Large syrphid fly (Syrphus pyrastri).

4. Parasite of European Fruit Lecanium (Comys fusca).

5. Scutellista (Scutellista cyanea).

II. Pollenizers.

1. Blastophaga (Blastophaga psenes).

2. The honey bee (Aphis mellifica). Also producer of a very important commercial product.

Professor Frederick T. Bioletti:- List of grapes and olives suitable for study in the Rural Schools of California.

A. For the coast counties.

B. For the interior.

1. Varieties commonly grown.

2. " suitable for experimental planting.

(a) = suitable for arbors.

GRAPES. All Vitis vinifera unless otherwise indicated.

Wine:

A1. Zinfandel. Red, dry wine- the principal wine-grape of California.

A1. Palomino. White " " heavy bearer and much grown. (a).

A2. Barbera. Red, dry wine- high quality, not much grown.

A1. Semillon. White " " " " widely grown.

B1. Alicante Bouschet. Red, dry or sweet wine- Common.

B2. Valdepenas. Red, dry wine- not much grown, good quality.

B1. West's White Prolific. White, dry wine, heavy bearer, good quality.

Raisin.

B1. Muscat of Alexandria. The principal raisin of California produces the large raisins of Spanish type.

B1. Sultanina. (=Thompson Seedless). Produces seedless raisins. (a).

B2. Black Corinth. Produces the "Zante currants" of Greece. (a).

Shipping.

A1B1. Flame Tokay. The principal shipping grape of California grown in the warmer parts of the coast counties and the cooler parts of the interior.

B1. Malaga. White- the second most important.

B1. Emperor. Black or red according to locality.

Home Use.

A2. Rose Sultanina.(a). red.

A2. Pierce. (Vitis Labrusca) (a) Black and slip-skins.

A2.B2. Black Muscat. black.

B2. Gros Colman. black.

A1.B1. Palomino (a) white.

OLIVES.

B1. Mission. Nine-tenths of all Californian olives are of this variety.

A2.B2. Ascolano. Very large; does well in most localities.

A2.B2. Redding. Useful only to produce seedlings for propagation purposes, or as an ornamental tree.

Grafting Stocks (phylloxera resistant) for vines.

A1.B1. Rupestris St. George.
A2.B2. Riparia x Rupestris 3309.

Professor Ira J. Condit:- Tropical and Semi-Tropical Fruits for Study in California Rural Schools.

Lemon- Eureka, Lisbon, Villa Franca.

Orange- Washington Navel, Valencia, Mediterranean Sweet.

Grapefruit- Marsh, Duncan Triumph.

Fig- Calimyrna, Adriatic, Mission.

Avocado- Taft, Sharpless, Harman.

Date- Deglet Nur, Thuri, Hayani.

Loquot- Champagne, Advance, Thales.

Japanese Persimmon- Hachiya, Tanenashi, Hyakume.

Guava- strawberry.

Pomegranate- Wonderful.

In addition to these the following fruits are grown here more or less commonly but are not represented by any commercial varieties, the Feijoa or Pineapple guava, the Jujube, the Cherimoya, the Pistachio nut, and the Mango.

Professor S. S. Rogers:- List of Garden Vegetables Suitable for Study in Rural Schools.

Vegetable	Variety.
Artichoke	French Globe.
Asparagus	Palmetto
Beans	Golden Wax, Kentucky Wonder, Canadian Wonder.
Beets.	Crosby's Egyptian, Dupont Red, Crimson Globe.
Cabbage	Early Flat Dutch, Early York, Winningstadt.
Carrots	Danvers Half Long, Long Orange, French Carrot.
Cauliflower	Early Paris, Snowball.
Celery	Golden Self-blanching, White Plume, Giant Pascal.
Corn	Crosby's Early, Oregon Evergreen, Late Alameda.

Cucumber	White Spine, Long Green.
Egg Plant	New York Improved
Lettuce	Los Angeles, California Cream Butter, Iceberg.
Muskmelon,	Jenny Lind, RockyFord.
Onion.	California Red, Italian Red, Australian Brown.
Watermelon	Chilean, Angelino, Kleckley Sweet.
Parsnip	Hollow Crown.
Peas	Telephone, Strategem, New Yorkshire Hero.
Pepper	Chinese Giant or Bell.
Potato, Irish	American Wonder, Early Rose, Burbank.
" Sweet	Merced Sweets.
Pumpkin	Mammoth King.
Radish	French Breakfast, Long Scarlet, Chinese.
Rhubarb	Crimson Winter, Strawberry.
Spinach	Prickley or Fall.
Squash, Summer	White Bush, Scallop, Yellow Crooked Neck.
" Winter	Hubbard.
Tomato	Sparks, Earliana, Stone.
Turnip	Purple Top Flat, Purple Top Globe.

Professor P. B. Kennedy:- Troublesome Weeds in California for Study in the Rural Schools.

Morning Glory - Convolvulus arvensis.

Occuring first as patches which may spread eventually over entire fields if not controlled. Troublesome in garden, orchard and field. A creeping plant with pernicious underground stems. Eradicated by suppression of the leafage which starves the rootstocks.

Johnson Grass - Andropogon halepense.

Troublesome only where winters not severe as in Southern California. Has large rootstocks which may penetrate to a depth of 4 feet in the orchards and fields. Eradicated by severe and continuous pasturing or by same methods as morning glory.

Dodders or Love Vines - Cuscuta sp.

Parasitic on alfalfas and clovers, sucking the nourishment from

them for their own use and finally destroying and taking the place of the host plant. Remedy, sow clean seed. Eradication by cutting and burning before going to seed. Reseeding with grass or grain or tillable crop for a period of one or two years. Then replant to alfalfa, using clean seed.

Mustards -Brassica sp.

Some produce as many as 15,000 seeds on a single plant. Troublesome chiefly in grains, especially in regions of continuous cropping. Seeds will lie dormant in the ground a long time, ten or fifteen years, and yet when brought near the surface will germinate. Remedy, clean seed and summer fallowing. Harrowing grain when young to destroy young and tender mustard plants. Spraying with iron-sulphate.

Barnyard Grass or Water Grass. - Echinochloa crus-galli.

Unusually troublesome in the rice fields, finally choking it out. Sometimes three-fourths of the rice crop is water grass. Remedy, clean seed, and pulling out and cutting the plants off below the crown with a hooked knife. Making clean and perfect seed bed so as to give the rice plants every chance.

Coast Dandelion - Hypochaeris radicata.

Has taken thousands of acres of pasture lands on the immediate coast. Remedy, grow grain for several years and ppevent going to seed. Summer fallow. Lawns and waste places of Berkeley.

Star Thistle, Napa Thistle)
Tocalote) Centaurea sp.

Common weeds in grain fields. Interfering with harvesting. Lessens the yield. Remedy, sow clean grain- prevent seed production. Hand pull

where not too abundant. Change to intertilled crop where possible. Clean summer fallow.

Bermuda Grass - Cynodon dactylon.

A persistent grass, troublesome chiefly in orchards. Portions of the plants separated in cultivation easily root and produce new plants. Spreads rapidly. Remedy, Repeated shallow plowing so as to expose roots to sun and frost. Sow the land to a crop which will produce dense shade which it dislikes, e.g. cow peas.

Sour Clover - Melilotus indica.

A valuable cover crop and at the same time a plant which causes great money loss to the wheat grower. A few seeds in a sack of wheat will taint the whole sack and make the flour unsaleable. Remedy, An annual so could be controlled by not allowing to go to seed. Thorough cleaning of grain at harvesting. Extremely abundant in California.

Wild Radish - Raphanus raphanistrum.

Particularly abundant in the coast region in oat fields. Looks like a mustard, except that the flowers are white or very pale yellow with purple veins and the pods are constricted between the seeds. Remedy, Try to stimulate seeds to germinate by cultivation and destroy young plants before seeding down to grain. Hand pull before seeding. Treatment with iron sulphate not quite so successful as with the mustards. Eaten by sheep and goats.

Mayweed or Dog Fennel - Anthemis cotula.

Roadsides, fields, vacant lots, grain fields, and pastures. Not eaten by stock, hence allowed to multiply and take up space where useful

forage plants should be growing. Remedy. As it is an annual, persistent prevention of seed production will eradicate it. In grain fields, the seedlings might be harrowed out in spring, in some soils. Ill-smelling foliage, white daisy like flowers.

Milk Thistle - Silybum marianum.

Recognized by its flecks of white on large prickly green leaves. Most abundant in the Bay region, but extending north to Mendocino and south to Los Angeles. Troublesome mostly in pastures, vacant lots, roadsides. Ordinance against it in Alameda County. Remedy. Spud below the ground when the plants are young in February. An hour's work at this time will save five later on. Prevent the plants going to seed. Plow and put into a cultivated crop. Stock do not care for it and so patches in pasture keep getting larger.

Nut Grass - Cyperus rotundus.

A sedge resembling a grass which bears little tubers on its roots the size of the kernels of a hazel nut. Propagates both by seeds and by these nutlets. Troublesome only when it gets into orchards. The tubers will withstand almost any degree of drouth. Remedy. Cut the stems so as to starve the roots and tubers. Plowing and cultivating seems only to give the weed renewed vigor. Hogs are very fond of it, and will root for the ground nuts.

Plantain or Buckhorn - Plantago Lanceolata.

In lawns and waste places, but especially troublesome in coast pastures. It has a strong perennial tap root which penetrates the soil for a foot or more, making it quite drouth resistant. Cattle feed on it when it

grows tall enough, but it is bitter and not a desirable plant for dairy stock. Sheep eat it and do well on it. It occupies space in the pastures that that should be growing more valuable forage plants. Remedy. Change of crop from pasture to grain or an intertilled crop for a period of years before reseeding. Sow clean seed.

Sour Dock or Sorrel - Rumex acetosella.

A frequenter of rather dry sandy or loamy soils, especially on the coast. It is a strong perennial spreading rapidly by means of slender rootstocks. The leaves are decidedly sour and disliked by stock. When present in any considerable quantity, it usually means a poor or acid soil. Remedy. It dislikes lime so apply heavy applications of lime which will encourage other and better forage plants. Cultivate the surface frequently and thoroughly so as to expose the rootstocks.

Curled Dock - Rumex crispus.

We often see considerable areas of our pasture lands, especially in the low places, occupied by this weed. Unlike the Sour dock, it has a long tap root. Cattle never eat it, so that it is left undisturbed to seed abundantly. Remedy. Pull up by the roots when the ground is thoroughly soaked by rains or irrigation. Keep cutting just below the crown so as to starve the roots. Change from pasture to grain or intertilled crops.

Professor W. Metcalf:- List of Some Common California Trees for Study in Rural Schools.

Pinaceae--Pine Family

Sugar Pine Pinus lambertiana.

Western Yellow Pine	Pinus ponderosa.
Digger Pine	" sabiniana.
Knobcone Pine	" attenuata
White Fir	Abies concolor.
Grand Fir	" grandis.
Douglas Fir	Pseudotsuga taxifolia.

Taxodiaceae--Big Tree Family.

Big Tree	Sequoia gigantea.
Redwood	" sempervirens.

Cupressaceae--Cypress Family.

Monterey Cypress	cupressus macrocarpa.
Incense Cedar	Libocedrus decurrens.
Sierra Juniper	Juniperus occidentalis.
Port Orford Cedar	Chamaecyparis lawsoniana.

Hardwoods or Broadleaved Trees.

Salicaceae--Willow Family.

Yellow Willow	Salix jasiandra
Fremont Cottonwood	Populus fremontii.

Juglandaceae--Walnut Family

California Black Walnut	Juglans californica.

Betulaceae--Birch Family.

White Alder	Alnus rhombifolia.

Fagaceae--Oak Family.

Valley Oak	Quercus lobata.
Coast Live Oak	" agrifolia
California Black Oak	" kelloggii

Lauraceae--Laurel Family.

California Laurel	Umbellularia californica.

Platanaceae--Sycamore Family.

Western Sycamore	Platanus racemosa.

Leguminosae-- Pea Family.

Mesquite	Prospis juliflora.
X- Black Locust	Robinia pseudacacia.

Sapindaceae--Buckeye Family

California Buckeye.	Aesculus californica.

Aceraceae--Maple Family.

Broadleaf Maple	Acer macrophyllum
California Box Elder	" Negundo (Californicum)

Ericaceae--Heath Family.

Madrona	Arbutus menziesii.

Myrtaceae--Myrtle Family.

X- Blue Gum	Eucalyptus globulus.

X= Not native but commonly planted.

Professor R. T. Stevens:- List of Flowers, Shrubs and Vines for Study in Rural Schools of California.

I- 20 CALIFORNIA WILD FLOWERS.

1- ANNUALS.

Clarkia elegans
California Poppy- Eschscholtzia californica
Birds Eyes - Gilia tricolor
Blazing Star - Mentzelia lindleyi
Farewell to Spring - Godetia grandiflora
Baby-Blue-Eyes - Nemophila menziesii
White Daisy - Layia glandulosa
Wild Canterbury Bells - Phacelia whitlavia.
Blue Lupine - Lupinus affinis
Innocence - Collinsia bicolor.

2.PERENNIALS:

Indian Paint Brush - Castilleja martini
Scarlet Larkspur - Delphinium cardinale.
Encelia californica.
Pride of California - Lathyrus splendens.
Yellow Tree Lupine - Lupinus arboreus.
White Evening Primrose - Oenothera californica
Scarlet Honeysuckle - Pentstemon cordifolius
Blue Pentstemon - Pentstemon spectabilis
Romero or Woolly Bluecurls - Trichostema lanatum
California Fuchsia - Zauschneria californica.

II- 25CULTIVATED FLOWERS.

1. ANNUALS:

Cornflower - Centaurea cyanus
Petunia hybrida
Shirley Poppy - Papaver rhoeas.
Scarlet Flax - Linum perenne
Nasturtium - Tropaeolum
Sweet Pea - Lathyrus odoratus.
African Marigold - Tegetes
Sweet Alyssum - Alyssum maritimum.
Verbena hybrida
Sea Lavender - Statice sinuata.
Zinnia
Butterfly Flower - Schizanthus wisetonesis.

2. PERENNIALS:

Candytuft - Iberis sempervirens.
Coreopsis lanceolata
Pentstemon gloxinioides.
Gaillardia grandiflora
Shasta Daisy - Chrysanthemum leucanthemum
Larkspur - Delphinum hybridum.
Valerian Centranthus ruber
Geum coccinea Mrs. Bradshaw.
Mourning Bride - Scabiosa maxima
Canterbury Bells - Campanula persicifolia
Marguerite - Chrysanthemum frutescens.
Gaura lindheimeri.
Hollyhock - Althaea rosea.

III- 15 NATIVE ORNAMENTAL SHRUBS

Catalina Island Cherry - Prunus illicifolia integrifolia
Madrone - Arbutus menziesii
Christmas Berry - Heteromeles arbutifolia
Wild Lilac - Ceanothus thyrsiflorus
Coffee Berry - Rhamnus californica
Palo Verde - Parkinsonia aculeata.
Silk Tassel Bush - Garrya fremontii.
Sour Berry - Rhus integrifolia
Carpenteria californica
Matilija Poppy - Romneya coulteri
Oregon Grape - Mahonia aquifolium
Fuchsia-flowered Gooseberry - Ribes speciosum
Monkey Flower - Diplacus glutinosus
Snowberry - Symphoricarpos racemosus.
Sweet-scented Shrub - Calycanthus occidentalis.

IV- 20 EXOTIC ORNAMENTAL SHRUBS

1. DECIDUOUS:

Japanese Quince - Cydonia japonica
Weigela - Diervilla Van Houttei.
Bridal Wreath - Spiraea cantoniensis.

2. EVERGREEN:

Abelia grandiflora
Darwin's Barberry - Berberis darwinii
Mexican Orange - Choisya ternata
New Zealand Looking Glass Plant - Coprosma baueri
Cotoneaster franchetii.
Escallonia montevidensis
" rubra
Small-flowered Fuchsia - Fuchsia magellanica
Italian yellow Jasimine - Jasminum humile
Australian Tea - Leptospermum laevigatum
Scarlet Bottlebrush - Melaleuca hypericifolia
Common Myrtle - Myrtus communis
Black-stemmed Pittosporum - Pittosporum tenuifolium (nigricans).
Burning Bush - Pyracantha coccinea (Crataegus).
Evergreen Thorn - Pyracantha crenulata (Crataegus).
Rapiolepis japonica
Veronica decussata.

V- 25 VINES

1. DECIDUOUS:

Akebia quinata.
Boston Ivy - Ampelopsis tricuspidata.
Virginia Creeper- Ampelopsis quinquefolia.
Mountain Climatis - Clematis montana
Blue Dawn Flower - Ipomoea learii.
Trumpet Vine - Tecoma grandiflora.
Chinese Wistaria - Wistaria chinensis.
Cobaea scandens -
Wild Pea Vine - Lathyrus latifolius.
Snail Vine - Phaseolus caracalla.
Actinidia chinensis.

2. EVERGREEN:

Australian Pea Vine - Dolichos lignosus.
English Ivy - Hedera helix.
Common Jasmine - Jasminum officinale.
Japanese Honeysuckle - Lonicera japonica halliana.
Maiden-hair Vine - Muehlenbeckia complexa.
Passion Vine - Passiflora caerulea.
Tecoma jasminoides.
Bignonia tweediana.
Evergreen Grape - Vitis capensis.
Chile Jasmine - Mandevilla suaveolens.
Potato Vine - Solanum jasminoides.
Evergreen Ampelopsis - Cissus striata.
Yellow Jasmine - Jasminum primulinum.
Carolina Yellow Jasmine - Gelsemium sempervirens.

VI. BULBS WHICH MAY BE PLANTED OUTDOORS IN FALL FOR SPRING AND SUMMER BLOOMING.

Daffodils or Jonquils
Large crown or trumpet type
Bicolor.
Yellow.

Short Trumpet type
Incomparabilis.
Poet's.
Double-flowered.

Narcissus - Polyanthus type - Paper white.

Iris -
Spanish in variety.

Iris (cont.)
German in variety.
English in variety.

Gladiolus -

Early dwarf types.
Blushing Bride.
Peach Blossom.
The Bride.
America.

Large-flowering hybrids in variety.

Amaryllis belladonna.

Anemone coronaria or Poppy-flowered.

Ranunculus -

Persian
Turban
French

Calla Lily - Richardia.

Common white.
Yellow spotted - Elliottiana.

Watsonia - white or pink.

Red Hot Poker - Tritonia

Montbretia - Orange

Freesia

African Blue Lily - Agapanthus.

Ixia in variety.

BULBS WHICH MAY BE GROWN INDOORS IN JARS AND POTS.

German Iris.

Narcissus - Polyanthus type - Paper White.

Tulips.

Daffodils.

Hyacinths.

Amaryllis.

Oxalis.

Freesia.

African Blue Lily - Agapanthus.

Professor C. F. Shaw:- Classes of Soils for Study in Rural Schools.

SOIL: -

The soil is a mass of finely ground and altered rock material mixed with a small amount of decaying organic material (or humus). Rocks are chipped and broken by alternating heating and cooling, are worn away or dissolved by water and are worn and altered by air. These various actions, together with the effects of plant and animal activities, break up and pulverize the rocks, making the fine mass we call"soil." Soils can be classified on the basis of their origin, as follows:

Sedentary
- Residual
- Cumulose

Transported
- Alluvial
  - Recent Alluvial
  - Old Alluvial
- Glacial
- Aeolian.

Sedentary soils are those in which the material has not been moved or transported from the place where it was formed.

Residual soils are sedentary soils formed by the accumulation of soil material through the decay and pulverization of rocks. Residual soils in many ways resemble the rocks from which they are formed. Soils

from sandstones are usually sandy, with more clayey subsoils. Soils from shale rocks are usually silts or clays, with heavy clay subsoils. Soils from granite-like rocks vary more, depending on their age, or on the amount of decay of the original rock material that has taken place. They may vary from sands to clays, on the surface, but usually have clayey subsoils.

Usually the residual soils have more clay in the subsoil than in the surface soil, and, below the subsoil, the half decayed rock is found, grading to the solid rock at greater depths.

Cumulose soils are sedentary soils that are formed by the accumulation of decayed plant remains. Peat and muck are those most commonly found.

Transported soils are those in which the soil material has been carried some distance from its origin and deposited in a new location.

Alluvial soils are those that have been moved and deposited by water.

Recent Alluvial soils are those in which the process of formation is still going on. They occupy alluvial fans, stream bottoms and basins, and are subject to overflow at each flood season. They are deep, and there is usually but little difference between the surface soil and subsoil.

Old Alluvial soils are those on which the waters have, for some reason, stopped depositing sediments, and which have been exposed to the rock destroying forces (changes of temperature, air, rains and plant and animal life). These soils have their particles altered and reduced in size, the finer ones being washed into the subsoil, making it

more clayer. Certain materials may be dissolved from the surface soils and filtered out and deposited in the subsoils, cementing them together. In this way hardpans may be formed and the value of the soil be decidedly changed. The Old Alluvial soils have more clay in the subsoil than in the surface soil, and often have a hardpan layer at from two to three feet below the surface. In most cases the material below the hardpan is loose and is good soil, and if the hardpan is broken so that the roots can get through it, they will find good soil in which to grow and obtain food. The Old Alluvial soils are usually rolling or slightly hilly, and may have low mounds or "hogwallows" formed on the surface.

Glacial soils are transported soils that are formed and transported by moving sheets of ice. They are of very limited occurrence in California.

Aeolian soils are transported soils that are transported and deposited by wind. Sand dunes are the most common aeolian soils. They are generally coarse and of low productivity, though in this state some very productive aeolian soils are found.

Physical character of soils.

Sand:- Sand is loose and granular. The individual grains can readily be seen or felt. Squeezed in the hand when dry, it falls apart when the pressure is released. Squeezed when moist it will form a cast, but will crumble when touched.

Sands are classified as coarse, medium, fine or very fine sands depending on the size of the grains that compose them.

Sandy loam:- A sandy loam is a soil containing much sand but which has enough silt and clay to make it somewhat coherent. It has a gritty feel, and the sand grains can readily be seen. Squeezed when dry, it forms a cast which can be easily broken, but if squeezed when moist, a cast is formed that can be handled carefully without breaking.

Sandy loams are classed as coarse, medium, fine or very fine sandy loams, depending on the size of the grains that compose them.

Loam:- A loam is a soil having an even mixture of the different sized grades of sand and of silt and clay. It is soft and mellow with a somewhat gritty feel, yet fairly smooth and rather plastic. Squeezed when dry, it forms a cast that will bear handling, while the moist cast can be handled quite roughly without breaking.

Silt loam:- A silt loam is a soil having little sand and only a small amount of clay, over half of the grains being of the size called "Silt". It may appear quite cloddy but the lumps can be readily broken, and when pulverized it feels soft and floury. Either dry or moist it will form casts that can be freely handled without breaking.

Clay loam:- A clay loam soil in the field is dense and compact and breaks into clods or lumps. These are hard to break when dry, but when moist can be pinched between the thumb and finger to form a thin ribbon. The moist soil is plastic and does not crumble readily.

Clay:- A clay soil is dense and compact, forming very hard lumps or clods. It is composed of very fine particles, which stick together to make a very plastic or putty-like mass when wet. The soil can be pinched out to form a long, flexible "ribbon".

Adobe:- The term "adobe" indicates a structural condition. Any soil that will shrink on drying and break into blocks with wide cracks, is called an adobe. Most adobes are clay adobes but there are clay loam adobes, and even sandy loam adobes have been found.

All of the above classes of soil, if mixed with a considerable amount of gravel, or of stone, may be classed as gravelly sandy loams, gravelly clays, etc. or as stony sandy loams, etc. Sandy clay, or sandy clay looms may also occur.

Alkali is a term applied to the accumulation of soluble salts in the soil in injurious amounts. "White" alkali is made up mainly of sodium chloride or common salt and sodium sulphate or glauber's salt. "Black alkali occurs when there is present a quantity of sodium carbonate or washing soda (sal soda). Alkali accumulates wherever there is poor drainage, and where there is more water leaving the soil by evaporation than goes down through it during rains.

Alkali can sometimes be made harmless by the application of chemicals, but the most satisfactory method is to remove it by draining and washing the salts out.

Professor R. H. Taylor:- Commonest and most generally applicable Varieties of Fruits for Study in the Rural Schools of California.

ALMONDS	WALNUTS	PECANS	CHESTNUTS	FILBERTS
Nonpareil	Franquette	Stuart	Paragons	Du Chilly
I. X. L.	Eureka	Schley	Boone	Barcelona
Ne Plus Ultra	Placentia	Success	Rochester	D'Alger
Drake		Moneymaker		Aveline, Red

APPLES

Yellow Newton — Winesap
Delicious — Gravenstein
Baldwin — Yellow Bellflower
Ben Davis — White Pearmain
Rome Beauty — Red Astrachan

PEACHES

Elberta - free) Shipping
Crawford ")
Muir ") Drying
Lovell ")
Tuscan Cling) Canning
Phillips ")

PEARS

Bartlett
Winter Nelis
Comice

QUINCES

Champion
Orange

NECTARINES

Stanwick
Boston

PLUMS

Wickson (Jap)
Climax "
Grand Duke
Diamond

PRUNES

French
Robe de Sargent
Imperial
Sugar

CHERRIES

Napoleon Bigarreau (Royal Ann)
Black Tartarian
Bing
Black Republican

APRICOTS

Royal
Blenheim
Moorpark

PLUMCOTS

Rutland

STRAWBERRIES

Jessie
Dollar
Longworth
Oregon
Marshall

RASPBERRIES

Cuthbert

BLACKBERRIES

Lawton
Mammoth
Himalaya

LOGANBERRIES

Logan
Phenomenal

HUCKLEBERRIES (wild)

SALMON BERRIES (wild)

Dr. C. B. Lipman:- A Few Facts about Plant Growth that may be taught in the Rural School.

FUNDAMENTAL PRINCIPLES: Everything which we perceive by the senses consists of one or more tangible units known as chemical elements or compounds.

Something cannot be derived from nothing.

Plants are made from substances known as plant foods.

These plant foods in turn consist of chemical elements bound together in different ways.

The plant is its own factory and produces its own foods as well as uses them.

These important plant foods are known as carbohydrates (examples:- sugar, starch, woody fibres), proteids (examples:- in animal bodies, white of eggs, casein from cheese, the muscle fibres in meat), and fats (examples: - cottonseed oil, olive oil, cocoanut butter.)

Only a few chemical elements are needed to build these very complex plant foods. They are carbon (obtained from the carbonic acid gas of the air) oxygen (obtained from the same source as carbon and also from water taken from the soil by the roots), hydrogen (obtained from water of the soil), nitrogen (obtained by the roots from salts known as nitrates which are found in solution in the soil moisture), phosphorus (obtained from salts known as phosphates which are contained in the soil moisture), potassium (obtained from combinations of other elements with the elements of potassium, also found in the soil moisture), calcium, magnesium, iron, and sulphur (all obtained from soil moisture in which they exist in combination with a variety of chemical elements in the form of water soluble salts).

In order to manufacture the plant foods carbohydrates, proteids, and fats from the elements obtained by the plant from sources and forms just described it needs energy and space and time.

By energy we mean something which if placed under the proper conditions will accomplish work. Thus we say not absolutely accurately but sufficiently so, for our purposes that steam is a source of energy to the steam engine, food is a source of energy to the animal, etc. in the case of the plant factory the energy is furnished by the light waves which come to us from the sun.

By space we mean room to do work. This is furnished in the case of the plant by the leaves and the actual work is done in those portions of the cells of which the leaf tissue consists which contain a green coloring material without which the light from the sun cannot perform the work of making plant food. The coloring matter mentioned is known as chlorophyll.

By time we mean a certain number of units reckoned as seconds, minutes, hours, days and years by which we record everything which happens in the world. Manufacturing plant food is a process which consumes a certain amount of time.

If we now have the leaf, the sunlight, the chlorophyll, and the elements or compounds from which plant foods are made, only time is necessary to build them. The elements carbon and oxygen which are taken by the plant from an invisible gas known as carbonic acid gas from the air are obtained by the absorption through numerous little slits or openings on the under sides of the leaves which are known as stomata. The other elements are carried by the roots by means of the stalks of plants to the leaves.

In the leaves, therefore, carbonic acid, water and the salts containing the necessary chemical elements meet and are made to combine in various compounds by the chlorophyll and the sunlight above mentioned

and built into the plant foods which we have studied.

Professor Harold C. Bryant:- A List of Common California Birds for Study in Rural Schools.

(The following birds have been selected from the more than five hundred different varieties found in California as being those most commonly met with. As a check-list of the commoner birds this list will be helpful but for more detailed descriptions and habits resort must be made to some of the books cited in the appended bibliography. It should be remembered that not all of the birds here listed are to be found in one locality or at one season of the year. - Harold C. Bryant).

WESTERN GULL. Larus occidentalis.

The commonest gull found along the California coast; recognized by its slaty-gray back and wings, black wing-tips and white head and underparts; young gulls are brownish with underparts streaked. Permanently resident, nesting on the Farallone Islands. A valuable scavenger.

GREAT BLUE HERON. Ardea herodias herodias.

A large bluish bird with extremely long legs usually seen wading at the edges of shallow ponds. Permanently resident. Valuable as a destroyer of pocket gophers which it secures by watching the gopher hole like a cat.

MALLARD. Anas platyrynchos.

Male with green head, white neck-ring, and chestnut breast; female dark brown streaked with lighter brown; both sexes with metallic purple patch on wing. Usually seen on or around ponds, lakes or streams.

Permanently resident. Considered our best table duck; feeds on grain and seeds of aquatic plants.

COOT OR MUDHEN. Fulica americana.

Slate-colored, with white bill; the commonest species of water-fowl found on lakes and ponds. Permanently resident. Feeds on grain, seeds and other vegetable matter; inferior to ducks for the table.

KILLDEER. Oxyechus vociferus.

Back brown; underparts white; black ring around neck and black band on breast. Usually seen in the vicinity of ponds and lakes; runs rapidly on ground and is noisy on the wing. Permanently resident. Feeds on snails, worms, and small insects secured on moist ground. Beneficial to agriculture.

VALLEY QUAIL. Lophortyx californica.

Helmet-like topnot drooping over bill; general tone of coloration gray; white and black markings on head and throat; breast slaty; rest of under parts scaled with black; brown spot on belly. Usually seen on ground in brushy areas, vineyards, orchards and grain fields. Permanently resident. Food chiefly weed seeds but some insects are taken; a fine game bird.

WESTERN MOURNING DOVE. Zenaidura macroura marginella.

Olive brown; tail long and pointed, broadly tipped with white on each side; sides of neck irridescent purplish and greenish. Usually found feeding on ground in open fields; when at rest perched in trees. A summer visitant, but winters to some extent in Southern California. Eats quantities of weed seeds and hence is beneficial to agriculture; considered a game bird in California.

TURKEY VULTURE OR TURKEY BUZZARD. Cathartes aura septentrionalis.

Large, black, with red featherless head: Usually seen flying high in air with motionless wings. A summer visitant in northern California, but permanently resident in southern California and the interior valleys. Valuable as a scavenger; feeds on carrion.

WESTERN RED-TAILED HAWK. Buteo borealis calurus.

Large, brown bird usually seen circling high in air with set wings. Permanently resident. Valuable as a destroyer of rodent and insect pests; seldom if ever attacks poultry.

COOPER OR BULLET HAWK. Accipiter cooperi.

A fast flying hawk of medium size with light spotted breast, slaty back and long tail banded with dark brown. Usually seen darting with quick stroke of wing near trees and thickets or high in air. A permanent resident. This is the real chicken hawk. Feeds on birds of all kinds, often preying upon quail and poultry. The Sharp-skinned Hawk is similar to the Cooper Hawk in coloration and habits but is only half its size, and a winter visitant, both are unprotected by law.

SPARROW HAWK. Falco sparverius sparverius.

Small reddish-brown hawk with black cheek marks. Usually seen perched on telegraph or fence posts or hovering over open fields. Permanently resident. Beneficial as a destroyer of grasshoppers, crickets and mice; seldom if ever attacks birds.

BARN OWL OR MONKEY-FACED OWL. Aluco pratincola.

Upper parts finely mottled with gray and light brown; under parts

white or light brown; face whitish. Usually seen in barns, hollow trees, or in the evening flying in search of food. Permanently resident. One of the most valuable of birds; feeds largely on the pocket gopher; has been known to capture as many as fifteen pocket gophers in one night.

BURROWING OWL OR BILLY OWL. Speotyto cunicularia hypogaea.

Brownish, barred with lighter brown and white; legs long for an owl; usually seen at entrance to squirrel burrow or perched on fence post. Permanently resident. Feeds on mice, ground squirrels, lizards, beetles, grasshoppers and other insects; a valuable ally of the farmer.

RED-SHAFTED FLICKER OR YELLOWHAMMER. Colaptes cafer collaris.

Upper parts pinkish brown barred with black; shafts of tail beneath and under side of wings red; black collar; conspicuous white rump patch. Permanently resident. Feeds largely on ants, as many as 3000 having been found in a single stomach; also takes wood-boring insects and small quantities of wild fruit; does not injure orchard trees.

CALIFORNIA WOODPECKER. Melanerpes formicivorous bairdi.

Upper parts black; under parts and rump white; forehead white; chin black margined with whitish; black patch on breast; white patch on wings shown in flight; Permanently resident. Usually seen on trunks and branches of trees, especially on those of oak. Acorns are the favorite food of this bird; these are stored in holes drilled in the bark of trees; ants and other insects are also eaten.

PACIFIC NIGHTHAWK. Chordeiles virginianus hesperis.

Dusky black, barred with gray and brown; white patches on wing

and throat. Usually seen in the evening flying high in the air or over thickets; flushed from ground in daytime on occasions. A summer visitant only. Feeds on flying insects such as ants, mosquitos, flies and moths; especially valuable as a destroyer of mosquitos.

ANNA HUMMINGBIRD. Calypte anna.

Upper parts irridescent green; top of head, throat, and ruff metalli pink, bronze and green in male; usually seen poised in mid-air over flowers, gathering food. Permanently resident. Feeds on tiny insects and nectar found in flowers.

BLACK PHOEBE. Sayornis nigricans.

Head and upper parts blackish; under parts white; crest on head. Usually seen about small bodies of water, bridges, barns, and houses. Permanently resident. A fine destroyer of the common house fly which it sometimes procures from window panes and window screens; other flying insects are also eaten.

WESTERN KINGBIRD OR BEE MARTIN. Tyrannus verticalis.

Head and back grayish; under parts yellow; tail black, with outer feathers edged with white; a patch of scarlet on crown of head usually concealed by feathers. Usually seen in open country or perched on telegraph wires or fences. A summer resident. Feeds almost entirely on insects, many of which are injurious; when feeding upon bees takes drones rather than workers.

CALIFORNIA JAY. Aphelocoma californica californica.

Head and back bright blue; breast and under parts whitish; long tail. Usually seen in orchards, thickets or wooded areas. Permanently

resident. Feeds largely on acorns, seeds and fruit but is often destructive to fruit and almond orchards and to the eggs and young of song birds and even poultry. The darker blue jay with a crest found in the mountains is the Blue-fronted Jay.

WESTERN MEADOWLARK. Sturnella neglecta.

Above streaked with gray and brown; yellow below with black collar on breast; two outer tail feathers white; bill about as long as head. Usually seen in open fields on the ground but sometimes perched on telegraph poles and fence-posts. Permanently resident. Feeds on grain, seeds and insects; as a rule a valuable ally of the farmer because of its destruction of insect pests, such as grasshoppers, crickets, wireworms and cutworms.

BULLOCK ORIOLE. Icterus bullocki.

Top of head, back and narrow throat patch black; white patch on wing; under parts orange yellow in male, lighter yellow in female. Usually seen in trees. A summer visitant. The oriole eats some fruit but most of the food is made up of injurious insects such as black scale, and codling moth.

BI-COLORED BLACKBIRD. Agelaius gubernator californicus.

Male black with red patch on wing; female gray, streaked with brown. Usually seen in marshes or near tules. Permanently resident. Feeds on grain, weed seeds and insects; sometimes destructive to grain and Egyptian corn.

BREWER BLACKBIRD. Euphagus cyanocephalus.

Male glossy blue black; white eyes; female brownish; walks instead of hops. Usually seen on the ground, or lawns, or in fields or

orchards, but also perched in pine trees or on telegraph wires. Permanently resident. Destroys some grain but usually compensates for it by the destruction of grasshoppers, white-grubs, wireworms, cutworms and weed seeds.

SONG SPARROW. Melospiza melodia.

Above dark brownish; below whitish conspicuously streaked with dark brown; a light streak over eye and a light stripe down center of head. Usually seen on ground or in bushes. Permanently resident. Feeds almost wholly on weed seeds; a fine singer.

LINNET OR HOUSE FINCH. Carpodacus mexicanus frontalis.

Male with red head and rump; otherwise gray, streaked with brown; female grayish obscurely streaked with light brown. Usually seen about houses, gardens and orchards, and about weed patches; often perched on telegraph wires. Permanently resident. Destructive to fruit; during the winter feeds on weed seeds. Not protected by law.

ENGLISH SPARROW OR HOUSE SPARROW. Passer domesticus.

Head gray bordered with stripes of chestnut in male; back brown streaked with black; under parts gray; throat balck; female less brightly colored and lacking black throat patch. Usually seen feeding on the ground in streets or about houses. Permanently resident. Introduced from England many years ago, it has spread rapidly and now is to be found throughout the State. Destroys grain, fruit and vegetables and drives away native insectivorous birds; a bird pest not protected by law.

WHITE-CROWNED SPARROW. Zonotrichia leucophrys.

Ashy gray, the back streaked with brownish; a white crown patch bordered by bands of black which in turn are bordered on each side with

successive streaks of white and again of black. Usually seen on ground about brush piles or bushes. One white-crowned sparrow, the Nuttall Sparrow, is a permanent resident; another, the Intermediate Sparrow, is a winter visitant. Sometimes destroys sprouting vegetables and fruit buds, but feeds largely on weed seeds.

GREEN-BACKED GOLDFINCH. Astragalinus psaltria hesperophilus

Top of head black; back olive green; white bar on wing; under parts yellow; often called "wild canary". Usually seen feeding in weed patches but often in gardens, orchards and fields. Permanently resident. A fine singer and valuable as a destroyer of weed seeds.

CALIFORNIA TOWHEE OR BROWN BIRD. Pipilo crissalis.

Plain brown above and below; a bright, reddish brown patch beneath tail. Usually seen feeding on ground near shrubbery in yards, orchards or brushy areas. Permanently resident. Food chiefly weed seeds.

BLACK-HEADED GROSBEAK. Zamelodia melanocephala.

Head and back black; breast and rump cinnamon brown; white patch on wings; female lacks black which is replaced by brown. Usually seen in orchards or in trees along streams. A summer visitant. A fine singer and beneficial in the destruction of black scale and codling moth; destroys some fruit.

CLIFF SWALLOW. Petrochelidon lunifrons lunifrons.

Back bluish black, forehead whitish or brownish; a gray collar on neck; chin, breast and rump brown; tail short and square. Usually seen flying about buildings or cliffs where it builds mud nests. A summer visitant. The food is composed of flying insects, many mosquitos are eaten.

CALIFORNIA SHRIKE OR BUTCHER BIRD. Lanius ludovicianus gambeli.

Above slate gray; below, grayish white; wings black with white patches; bill hooked; black stripe through eye. Usually seen perched on tree, telegraph wire or fence post. Permanently resident. Beneficial as destroyer of mice and injurious insects which are often impaled on thorns and barbed wires; occasionally kills small song-birds.

WESTERN WARBLING VIREO. Vireosylva gilva swainsoni.

Above olive gray; below whitish; white superciliary stripe. Usually seen in foliage of trees along stream. A summer visitant. Food is made up of insects and larvae taken from foliage of trees.

AUDUBON WARBLER. Dendroica auduboni.

Above and below bluish slate streaked with black; white patches on wings and on outer tips of tail; a patch of yellow on top of head, throat, shoulders and rump. Usually seen feeding in the foliage of trees or capturing insects in the air like a fly-catcher. A winter visitant, breeds in high mountains. Feeds entirely on insects.

WESTERN MOCKINGBIRD. Mimus polyglottos leucopterus.

Above gray; below, whitish; white patch on wings; two outer tail feathers white. Usually seen near citrus orchards, houses or along arroyas. Permanently resident in southern California. Sings at night; eats insects, berries and fruit.

WESTERN HOUSE WREN. Troglodytes aedon parkmani.

Above brown, finely barred with blackish; tail held at angle to body, barred with gray and black; below ashy brown. Usually seen about houses or buildings where it nests in holes or in wooded areas where it nests

in cavities. A summer visitant except in parts of southern California. Feeds entirely on insects.

CALIFORNIA BUSH-TIT. Psaltriparus minimus californicus.

Small, gray bird with long tail and small bill. Usually seen in flocks (in winter) feeding in foliage; individuals of flock keep up constant chatter; build long hanging nests. Permanently resident. Insects harmful to trees such as scale and caterpillars form the chief food.

WREN TIT. Chamaea fasciata.

Brownish; long tail held wren-like. Usually seen in shrubs or bushes; the call a loud whistle on same pitch with each succeeding not shorter, is often heard in brushy canyons. Permanently resident. Feeds on insects.

WESTERN ROBIN. Planesticus migratorius propinquus.

Head blackish; back slaty; tail blackish; throat white; breast reddish brown; belly white. Usually seen on ground or in trees. Permanently resident in mountains but a winter visitant in the valleys. Earthworms, insects, berries and fruit are eaten.

WESTERN BLUEBIRD. Sialia mexicana occidentalis.

Male, above bright blue; throat blue; breast and sides chestnut; belly white; female with gray largely replacing blue and chestnut, making coloration much dullar. Usually seen in open fields, orchards, and wooded areas. Permanently resident. Food chiefly insects, many of which are injurious to crops.

BOOKS ON BIRDS.

Bailey F. M.

1914. Handbook of birds of the western United States (4th revised, ed. Houghton, Mifflin Co., Boston and N. Y.), li, 1-570, 36pls., 2 diagrams, 601 figs. in text. Price $3.50. (The best handbook on western birds; contains good keys to the species.)

Finley W. L.

1907. American birds (Chas. Scribner's Sons, N. Y.), xvi, 1-256, 127 figs. in text. Price $1.50. (General account of habits of many western birds; suitable for general reading).

Myers H. W.

1913. The birds' convention (Out West Magazine, Los Angeles, Cal), pp 1-81, 36 figs. in text. Price 75¢. (Excellent for use as a supplementary reader by the grammar school teacher.)

Torrey, B. B.

1913. Field days in California (Houghton, Mifflin Co., N. Y.), 12, 235, 9 pls. Price $1.50. (Personal reminiscences; many references to the habits of California birds. Thoroughly accurate, and reliable; good style).

PAMPHLETS.

The following bulletins and circulars giving details as to food habits of birds, can be obtained free by applying to your congressman at Washington, D. C., or at a slight cost from the Superintendent of Documents, Washington, D. C.

Beal, F. E. L.

1904. Some common birds in their relation to agriculture. United States Department of Agriculture, Farmers Bulletin 54, pp 1-48, 22 figs. in text. (Food habits of many California birds) 5¢.

1904. The relation of birds to fruit growing in California. U. S. Dept. of Agriculture, Annual Report, 1910, pp 241-254. 5¢.

1907. Birds of California in relation to the fruit industry. Part 1, U. S. Dept. Agric., Biological Survey Bulletin 30, pp. 1-100, 5 pls. 20¢.

1910. Birds of California in relation to the fruit industry. Part II, U. S. Dept. Agric. Bur. Biol. Surv. Bull. 34, pp 1-96, 6 colored plates. 40¢.

Beal, F. E. L. and McAtee, W. L.

1912. Food of some well-known birds of forest, farm and garden. U. S. Dept. Agric. Farmers Bulletin 506, pp. 1-35, 16 figs. in text. (Many references to food of California birds.) 5¢.

Professor Harold C. Bryant:- A list of Common California Mammals for Study in Rural Schools.

CALIFORNIA MOLE. Scapanus latimanus.

About 6 inches long; short tail; brownish glossed with silvery; no visible ears; minute or rudimentary eyes; broad flattened front feet with strong claws. The workings usually a ridge on the surface of the ground, but sometimes a mound of earth, are more often seen than the animal itself. The principal food is earthworms, larvae and insects; so far as food is

concerned the mole is a benefit but the animal often destroys garden truck and is destructive to lawns because of its habit of working about among the roots and allowing them to dry out.

PACIFIC PALLID BAT. Antrozous pacificus.

Bats are the only mammals with well-developed powers of flight; this bat is of large size (3 inches), large ears, and is buffy brown above and dull white below. Usually seen flying about in the air at twilight on summer evenings, but sometimes hanging head-downward in the daytime in old buildings. Feeds on boring beetles, Jerusalem crickets, tomato worm moths and other injurious insects; wholly beneficial.

CALIFORNIA VALLEY COYOTE. Canis ochropus.

About 45 inches long; above mixed with buffy and black; below whitish tinged with buff; long nose; sharp, pointed ears; bushy tail. Usually seen loping across open fields, but most often recognized by its peculiar bark heard at night. Feeds on small mammals such as rabbits, squirrels and gophers, and on insects; more rarely on carrion; destructive to sheep and poultry but often a valuable ally in holding rodent pests in check; dangerous as a carrier of rabies.

KIT FOX. Vulpes macrotis.

About 37 inches long; grayish buff with buffy breast and front legs, and buffy white underparts; tip of bushy tail chestnut. Seldom seen, as it prowls about only at night. This is the fox of the open country. Feeds largely on small rodents.

CALIFORNIA COON. Procyon psora.

Total length about 33 inches; general coloration grayish; a broad

black band across each side of the face taking in the eyes; tail brownish with five to seven rings of dusky or black; tip of tail black. Seldom seen except at night or when trapped; characteristic tracks often to be noted along streams or about tule patches. Food includes mice, small birds, insects, frogs, fish and fruit; sometimes destructive to poultry.

SPOTTED SKUNK. Spilogale phenax.

About 15 inches long; black with four parallel white stripes on back, these stripes often broken up into spots; a white spot on forehead; terminal third of tail white. Hides in daytime, but is often seen moving about at night; sometimes called hydrophobia skunk. Feeds on mice, birds, eggs, insects and grubs; often destructive to poultry.

CALIFORNIA STRIPED SKUNK. Mephitis occidentalis.

About 27 inches long; black; a narrow white stripe on top of head; a broad white stripe starting on neck, dividing on shoulders and extending along each side onto the tail. Usually seen at night unless dislodged from its hiding place. Feeds on mice, small birds, eggs, frogs, insects and grubs; sometimes destructive to poultry and bees.

CALIFORNIA BADGER. Taxidea neglecta.

About 29 inches long; stout; grayish tinged with brown; a narrow white stripe over head and down back; nose, sides of face, and patch in front of ear black; fore claws long and only slightly curved. Usually seen seated in front of burrow or digging. Food is composed largely of small rodents; beneficial to agriculture.

CALIFORNIA WILD CAT. Lynx californicus.

About 32 inches long; above grayish spotted with brown or black;

tail short, black-tipped and with black bars; tufts on ears. Occasionally seen in wooded and brushy areas in the daytime, but hunts largely at night. Feeds on small mammals and birds and on poultry.

WHITE-FOOTED MOUSE OR DEER MOUSE. Peromyscus maniculatus.

About 6 inches long; ears large; feet white; grayish brown above, white below; tail blackish above. Usually seen in brushy areas; often lives in nests of the wood rat; seldom feeds during daylight. Food is made up of vegetable material, mostly seeds, stems and leaves of plants.

WOOD RAT OR TRADE RAT. Neotoma fuscipes.

About 15 inches long; tail long; large ears; above grayish brown, below grayish white; fore feet and toes of hind feet white; tail blackish. Usually seen in brushy areas in close proximity to the large cone-shaped piles of sticks which serve as a nest; sometimes seen in trees. The food is varied, but made up largely of vegetable material such as seeds, stems, and leaves of plants.

CALIFORNIA MEADOW MOUSE. Microtus californicus.

About 5 inches in length; relatively short tail; small ears; above brownish; below dark gray. Usually seen in grassy fields or meadows where a network of runways, some above and some below the surface, are in evidence. Feeds on the stems and leaves of grass and other plants; sometimes destructive to alfalfa and other growing crops.

CALIFORNIA POCKET GOPHER. Thomomys bottae.

Six to nine inches long; body stout, blackish brown in color; eyes and ears small; prominent incisor teeth; external cheek pouches on

each side of mouth. Usually seen poking its head out of the entrance of, or pulling weed stalks into the burrow; a succession of mounds of earth indicate plugged-up entrances to the burrow. Food is composed of succulent roots and stems of plants and trees; destructive to fruit trees, alfalfa and vegetables and other growing crops.

CALIFORNIA GROUND SQUIRREL. Citellus beecheyi.

About 16 inches in length; tail long; ears large; above grayish brown finely spotted with whitish; a whitish patch on the sides of the neck extending backward onto the sides; tail brownish. Usually seen running or standing picket-like in open fields; lives in colonies; burrows characteristic. Feeds on grain, seeds, nuts, green plants and vegetables; destructive to grain and other growing crops; dangerous as a carrier of bubonic plague.

CHIPMUNK. Eutamias (various species).

Seven to eight inches long; brownish with dark stripes along face and five stripes of dark brown down back separated by four light stripes. Usually seen in brushy or forested areas in the mountains. Food largely seeds

GRAY SQUIRREL. Sciurus griseus.

About 22 inches long; gray grizzled with white; dull white eye ring; tail flattened, long and bushy. Usually seen in trees. Feeds largely on acorns and pine nuts.

CALIFORNIA JACK RABBIT. Lepus californicus.

About 22 inches long; grayish mixed with black and tinged with brown; long ears tipped with black; tail black above, grayish below. Usually seen in open fields. Food consists of herbage of all kinds; destructive to young trees because the bark is eaten.

COTTONTAIL. Sylvilagus auduboni.

About 15 inches long; grayish above; throat and belly white; tail grayish above, white beneath. Usually seen in brushy areas where open spaces are to be found. Food composed of small plants, twigs and bark; sometimes destructive to young trees.

CALIFORNIA BRUSH RABBIT. Sylvilagus bachmani.

Above grayish brown mixed with blackish and tinged with brown, tail small, tinged with grayish brown above and on sides, white below; distinguished from cottontail by darker color, and shorter ears and tail. Usually seen in thick brush seldom venturing far from its shelter. Food largely the stems, leaves and bark of plants; widely used as food.

BLACK-TAILED DEER. Odocoileus columbianus.

Male with antlers; in winter grayish; in summer brownish; has shorter ears and is not as large as mule deer which is found in the Sierras. Usually seen in forested or brushy areas in Coast region north of San Luis Obispo County. Food largely leaves and twigs. One of the best large game mammals; about 12,000 deer are killed annually in this state.

BIBLIOGRAPHY.

Grinnell, J.
1913. A distributional list of the mammals of California. Proc. Calif. Acad. Sci., 4th Ser., 3, 265-390, 2 pls.

Seton, E. T.
1910. Life histories of northern mammals. (Chas Scribner's Sons, N. Y.), 2 vols., xxx, 1267, 46 pls., 182 figs.

Stephens, F.
1906. California mammals. (West Coast Pub. Co., San Diego, Calif.)

Stone, W. and Cram, W. E.
1902. American animals. (Doubleday, Page & Co.), xxiii 318, numerous pls., many figs. in text.

Course of Instruction in Agricultural Nature Study Suitable for the Rural Schools of California.

A. The material that follows is grouped under four general topics, viz:-

1- Human Needs, Interests and Activities.

2- Plant Life.

3- Animal Life.

4- Natural Phenomena and the Inorganic World.

B. Since human needs are considered, the physiology and hygiene for the first six grades is included in nature study. The instruction in Physiology and hygiene may be given during the worst weather of the winter months when there is more need of emphasizing the care of the body and the observance of health conditions in general. Besides, this work lends itself to indoor instruction when weather conditions forbid much outdoor work. If desired an elementary text as "Health Lessons," " The Body in Which We Live", etc., may be used as a health reader in the Third, Fourth Fifth, and Sixth Grades. Of course for the First and Second Grades all instruction in health lessons and nature study is oral.

C. See Part II, Elements of Agriculture, for outlines and materials for course of instruction in elementary agriculture for the Seventh and the Eighth grades. This Part II may be substituted for the work outlined below for the Seventh and the Eighth grades in Agricultural nature study. As a matter of fact the difference between Agricultural nature study and the

elements of Agriculture in these two grades is not very marked. As was stated on pages 19 and 20 of these outlines; "It makes no difference whether we call it elementary Agriculture or Agricultural nature study; it is the same thing and should be so understood. It is the study of plants and animals, of soils and weather, of natural forces and phenomena, of the interrelations and interdependence of natural objects; of the relation of all these to men, and of man's power in controlling them and making them work for his good." Beginning with "VII" on page 17 and ending with "9" on page 20 review the readings there assigned.

D. See Part III, Elements of School Gardens - Also Home Gardens - for suggestions as to out-door laboratory work and project work.

E. Finally, the following outlines are suggestive only. The last word has not yet been said with reference to the selection of material for any course of instruction in nature study and agriculture. It is hoped that the suggestions that follow will prove helpful. The teacher is urged to improve on them. See again pages 9, 10 and 16 of these outlines.

I- Outlines for First Grade.

Children of the First and the Second grades want to know their environment in a large, general way and are not old enough to be interested in minute details. Review pages 39, 40 of these outlines, noting references 4,5.

1. Human Needs, Interests and Activities.

Informal talks with the children about their homes to make them feel at ease in the school and to show them that the school is interested in the home life of its pupils. Encourage each child to have a part in these conversational lessons, thus giving opportunities for drill in correct oral

expression in things related to the life of the child.

The Home:- The house and the need of shelter. Materials that enter into the construction of the house. Where obtained? Labor needed in the construction of the house. Heating-ways; lighting as candles, lamps, electric, gas; water in the house. Description of the house, rooms with furnishings, conveniences, etc. The surroundings of the house, the lawn with its trees, shrubs, vines and flowers. Changes about and in the house because of seasonal changes in weather. Health and hygiene of the home. Duties of the various members of the household in making the house attractive and comfortable. Ideas in cooperation with certain activities. Find out what the child does or contributes to this social service. Play activities of the children at home; the pleasures of family life, the visits of neighbors, etc. Homes of boys and girls in other lands. In short, questions and talks in language suited to beginners to show the universal human need of shelter and the importance of the home as the basal institution in community life. Keep in mind the fundamental principle of pedagogy, Viz: "Teaching both in matter and method, must be adapted to the capability of the taught." See pages 42 and 43.

Food:- A second fundamental human need. Have the children name all the different foods that come from the garden; from the field; from the orchard; from animals; from the store. When harvest and how store products of garden, field and orchard? Provisions for the future. Changes in certain articles as wheat into flour, etc, processes, where and by whom. Things that cause a shortage of food. Work of various members of the household in the growing and the preparation of food. Duty of the child as an economic factor. The needed articles of food - salt, sugar, etc - not grown or found

in the pupil's locality or state. How secured? Bring out the idea that the entire world is a great human family where it is the duty of each person toncontribute something of benefit to some one. The interrelation and interdependence of peoples and communities. Begin to develop in country children the social, cooperative, community ideal as opposed to the selfish individualistic idea.

Clothing:- A third fundamental human need. Kinds of clothing, woolen, linen, cotton, silk, leather, etc., and where each is obtained. Uses of clothing. Seasonal changes and adjustment of clothing. Talks about clothing and drygoods stores. Preparation of clothing. Care and hygiene of clothing. Clothing for indoors and out-of-doors. Clothing of primitive people. Clothing of peoples of other lands. Contrast Alaska and Hawaii. Discussion of need of keeping the clothing and the body clean will aid in fixing hygienic habits.

Health Lessons:- Any good elementary text in physiology and hygiene will furnish abundant material as the basis of many important health talks. Air, food and water needed to sustain life. How is air made impure? Bad odor in the room, how caused? Need of ventilation and how secured. Work of the lungs. Why keep the skin clean? How often Bathe? Care of teeth, hair, faces, hands and nails. Keeping school materials clean, desks, books, drinki cups, etc. Preparation of foods. Best ways of cooking different foods. Name foods best for the different meals. What constitutes a good school lunch? Manner of eating. Various items in house cleaning after the winter or rainy season is over. Cleaning of the yard. Children help in house-cleaning.

Seasonal Activities:- Character of work on the ranch during the

dry season, haying, harvesting grain, picking fruit, etc. After sufficient rain, the plowing and seeding. The annual pruning of orchards and vineyards, why? The spraying of fruit trees, etc., why? Cultivation of orchards and vineyards, why? Conservation of water supply, irrigation. Dust in roads how controlled? Special industries as canning, pickling, lumbering, etc., in the particular community. Outings, fishing trips, hunting, neighborhood picnics, community fairs and various other agencies for recreation and the socialization of country life. Play festivals for old and young.

Institutional Life:- Need of a school house, a church. Activities of folks that cause the need of other public places, such as the store, creamery, blacksmith shop, post office, depot, factory, etc. Value of good roads. Emphasize the ideas of interdependence and the spirit of service. What things can the children do to make and keep the school house and grounds wholesome and attractive?

2. Plant Life Throughout The Year.

Building up an appreciation of good things on the part of young children can be accomplished through the study of nature if the teacher has the proper "background" of appreciation of excellence in plant and animal life. The more detailed study of things must be left to the upper grades. Primary children are interested in whole objects rather than in parts and in useful objects rather than those which seem to have no direct service. Bailey' new book, The Holy Earth, has some most excellent chapters for the teacher of nature subjects. One quotation from the chapter, "The Admiration of Good Material" is here given to illustrate what is meant by a "background of appreciation of excellence" for the teacher as a proper preparation in the

beginning of the study of plant life, and animal life for that matter. Says Bailey, "In physical perfectness of form and texture and color there is nothing in all the world that exceeds a well-grown fruit. Let it lie in the palm of your hand. Close your fingers slowly about it. Feel its firm or soft and modelled surface. Put it against your cheek, and inhale its fragrance. Trace its neutral under-colors, and follow its stripes and mark its dots. If an apple, trace the eye that lies in a moulded basin. Note its stem, how it stands firmly in its cavity, and let your imagination run back to the tree from which, when finally mature, it parted freely. This apple is not only the product of your labor, but it holds the essence of the year and it is in itself a thing of exquisite beauty. There is no other rondure and no fragrance like this."

"I am convinced that we need much to cultivate this appreciation of the physical perfectness of the fruits that we grow. We cannot afford to lose this note from our lives, for this may contribute a good part of our satisfaction of being in the world. The discriminating appreciation that one applies to a picture or a piece of sculpture may be equally applied to any fruit that grows on the commonest tree or bush in our field or to any animal that stands on a green pasture. It is no doubt a mark of a well-tempered mind that it can understand the significance of the forms in fruits and plants and animals and apply it in the work of the day."

Fruits:- Have children name different fruits and nuts that grow in the district. Name those that have ripened before school opened or that are now ripe. If possible let each child bring to school the best peach, pear, apple, orange, lemon, walnut, olive, bunch of grapes, etc., grown at

home. Talk about points of excellence in form, color, flavor to develop that "Admiration of Good Materials" mentioned by Bailey. The husbandry necessary to produce perfect fruit. The cost of success. Various ways of disposing of the fruit grown in the orchards.

Fruit Trees:- Names of various kinds in the neighborhood. General appearance. Do leaves stay on all winter? Watch for the blossoms in the proper season. General talk about the care of fruit trees. Each child describe its favorite fruit tree at home and tell why it is a favorite.

Shade or Ornamental Trees:- Identification and items of interest about the common ones found around the homes or on the school road. Why protect the trees. Color of foliage.

Forest Trees:- Names and general appearance of any that may be found in the neighborhood. The pine or fir and Christmas stories.

Wild Flowers:- Any wild flowers in blossom during the dry season? What came back to life with the rainy season? After the snow passes away? Make a list on the blackboard of a dozen or so of the most common wild flowers. Collect seeds of a few to plant. Avoid wanton destruction of blossoms.

Cultivated Flowers:- Acquaintance with a few of the most common found around the homes as geraniums, nasturtiums, verbena, morning glory, petunia, sweet pea, etc.

Field Plants:- Children name the different plants that are useful as wheat, oats, alfalfa, etc. Distinguish a head of wheat from a head of oats. Names and identification of two or three noxious plants or weeds grown in the fields.

Garden Plants:- Discussion in general terms about the kinds of plants grown in the garden, uses, etc. What things helped the plants to grow? Who took care of them. Suggestions to children to save a few seeds for their own garden next year. Who makes a garden and what things are done?

Thanksgiving Festival:- Good moral teaching to celebrate the yearly bounty of garden, field and orchard. Story of the Puritans. Display of best farm products in the school Arrange exhibits with reference to color effects and educational influences. Use of both cultivated and wild common products. Make the exhibit a social occasion for the community. All grades of the school must have a part in this. There need be no competition or prizes even, simply a show for its own sake. "An apple day or an Apple Sabbath would teach the people to express their gratitude for apples. The moral obligation to grow good apples, to handle them honestly, to treat the soil and the trees fairly and reverently, could be developed as a living practical philosophy into the working-days of an apple-growing people." Bailey, the Holy Earth. p. 113.

3. Animal Life Throughout the Year.

Common Domestic Animals:- Name the various animals of pasture and barnyard. The pets of the household, poultry, etc. Have children talk about care of animals, the service they render in the way of labor, food and pleasure. Emphasize the cow and the hen. Emphasize cleanliness of cow-barn and chicken house. Sanitary milk and egg production. Create appreciation of the best in animal life. "The admiration of a good domestic animal is much to be desired. It develops a most responsible attitude in the man or the woman. I have observed a peculiar charm in the breeders of these

wonderful animals, a certain poise and masterfulness and breadth of sympathy. To admire a good horse and to know just why he admires him is a great resource to any man, as also to feel the responsibility for the care and health of any flock or herd. Fowls, pigs, sheep on their pastures, cows, mules, all perfect of their kinds, all sensitive, all of them marvelous in their forms and powers, -- verily these are good to know." Bailey, in The Holy Earth, page 111.

Wild Animals:- Name such as may be found in the locality, rabbits, gophers, deer, bear, etc. Which are injurious to the farmer and how? Means taken fro extermination of enemies to plant and animal life on the farms.

Birds:- What birds are present when school opens? What have gone? Which come with the rainy season and the opening of spring? What ones stay all winter? Make a few simple observations on two or three of the most common birds during the year. Find out what the children already know about birds, create in them a desire to know more about bird life and leave to the other years a progresive study of details.

Insect Life:- Interest the children to watch grasshoppers, butterflies, bees, etc. Do not make this first year an intensive study in economic entomology. Have them know what an insect is, if they do not know. Have them know in a general way about two or three common insects injurious to garden, field and orchard. Detailed study in later years.

4. Physical Phenomena and the Inorganic World.

Weather:- Effects of long dry season. Change of Season. Rain. Clouds. Winds, Snow, ice, frost, etc. The weather Calendar and use of the thermometer.

The Brook:- Action of running water. Stones, pebbles, sand. Erosion, gulleys, etc.

Soil:- Appearance dry season and wet season. Dust, mud.

II- Outlines for Second Grade.

1.Human Needs, Interests and Activities.

Summer Vacation Experiences:- Outings, picnics, fishing trips, visits to friends or relatives, etc. Work done by the children about the home, in the garden or in the fields. New things they have learned since school closed in the spring.

Health Lessons:- Talks about good articles of food for the various meals. Proper breakfast materials, summer and winter, for children as eggs, milk, fruit, cereals, Manners in eating. Thorough chewing and proper digestion. The school lunch, character and how eaten. Ways of making the schoo lunch more hygienic. Duty of the home and the school. The muscles. Development through activity as in work and play. Muscular activity and good food and fresh air. The hands and nails, why kept clean? Comfortable shoes and frequent bathing of the feet, why important? The eye, its importance and care. Proper light for reading. Danger in poor light. When use glasses. Testing the eyesight. Proper lighting of a school room. Things to be observed in the care of the ear. Danger of sudden and loud noises. Deafnes cause and inconvenience. The pleasant voice and how acquire it.

Seasonal Activities:- Kinds of work carried on the farm throughout the year. Children report on practice of farmers in preparing the ground for seeding, setting out trees, for irrigation, etc. Preparations for the home garden? Why cultivate the growing crops? What is done with the various

crops after they are harvested? What did each child do in the various farming operations? Emphasize the worth of the productive life and the social value of agriculture.

2. Plant Life throughout the Year.

Garden Crops:- Name different plants growing in the garden. Wh. was the seed planted? What care has the garden received during the summer? Mention any vegetables in the garden that have gone to seed, as radish, lettuce, peas, corn, beans, etc. Gather some seed and save for planting in the garden in the spring. Study in detail the radish or lettuce plant gone to seed noting root, stem, blossom, seed pods and seeds. Any vine crops in the garden. Study somewhat in detail, the pumpkin or squash, noting the character of the stem, the leaves and blossoms. During winter months arouse interest in the children for the spring garden work. Children help to make the window garden in the school room. Preparatory talks on the kind of box to hold the soil, the best kind of soil to put into the box and the best seed to plant with a view to transplanting at home. Encourage the idea of the "school-home" garden with the possibility of the school exhibit of things grown at home. The "egg-shell" garden especially appeals to children of the first two grades. Give careful directions about the soil, provision for drainage of the eggshell by making a small hole in the shell, how deep to plant the seed, what seed to plant, marking the shells, with owners' names, need of sunlight and moisture, etc. Each owner to take care of his own garden. Daily inspection of eggshells with record of observations. Discussion of things that may be planted during the rainy season. When rainy season is over or winter has passed away, discuss when

soil is dry enough to work, how to prepare the seed bed for sowing seeds or transplanting from window gardens or eggshell gardens. Why transplant? Show how this should be done. Do not try to grow too many different kinds. Emphasize one vegetable and one flower to be grown by young children at home, the products of which, either fruit or blossoms, may be exhibited at school the next fall. Suggestion of tomato or potato for the vegetable and aster or cosmos for the flower. Have a good seed catalogue, well illustrated, in the school room and examine pictures of garden vegetables and flowers. Children of this grade may plant seeds of gourds or some other vines to cover fence or screen to outbuildings.

Field Crops:- Have children report the different field crops grown in the community. Why grown? Do the farmers grow all their feed for their live stock? If not where do they get it? What is the principal cereal? If wheat, name different varieties. If corn, name varieties. If oats, name varieties. How is each crop harvested? How is it stored away for future use? If potatoes are not grown locally, where do people get their supply? What grasses, alfalfa, vetch, clover, etc., are grown by the farmers? How many families grow sugar corn or pop corn? How many grow pumpkins or squash in the fields? Begin to emphasize the value and need of a more diversified agriculture so that a community is not dependent upon a single crop.

Fruit Crops:- Name different fruits grown in the district. Make a list on blackboard of fruits of trees, vines and shrubs, as peaches, apples, prunes, oranges, grapes, olives, almonds, raspberry, currants, strawberries, etc. How can fruit trees be told apart when there is no fruit on them?

Have leaves and twigs from different trees in the school room. Why are trees and vines pruned? Watch the blossoms in the trees. What are the bees doing? What is one injurious insect for each fruit tree? How is the spraying done? What ripens the fruit? What labor is required to have good fruit? What is done with the fruit when picked? If in a raisin, walnut or olive district, emphasize best methods of preparing crop for the market. Teacher should get all possible information from the best grower in the community. Don't attempt to bring out all the technical information in the primary grades. Leave something for the upper grades.

Shade and Forest Trees:- Identify a few of the most important shade trees. How tell an acacia from a black walnut? How tell the valley oak from the black oak? What is the principal shade tree in the community? How many kinds of eucalyptus grown in the neighborhood? Do the leaves stay on all the year? How tell one pine tree from another? How many of the trees have blossoms? When does each tree blossom? Do they have seeds? If so, collect a few. How does the seed of the maple differ from the seed of the oak? Choose one tree to find out all the interesting things possible, as age, height, shape, manner of growth, direction of branches, color of leaves, limbs, and bark on trunk, the buds, shape of leaf, etc. Notice twigs and leaves of two or three other trees in contrast to the one chosen. The forest and what it means to mankind. Lumbering and reforestation. How observe Arbor Day in the best way? Are trees needed on the school ground?

Native Shrubs:- Any growing on the mountain side? In the canyon? Along the streams? In the open? Make a list of the wild shrubs in the neighborhood. Study one as to height, character of stem and branches, kind

of leaf, color of blossom, etc. Can some of these hardy native shrubs be transplanted? What are some of the things necessary to successfully transplant a shrub, tree or flower? Does the school yard need shrubs and flowers as well as trees?

Wild Flowers:- What wild flowers are in blossom when school opens. Put list on board. What ones have gone to seed? Collect a few seeds. Some autumn flowers may be used for school room decoration. Teach children how to gather wild flowers - a few for enjoyment and not for destruction. Suit the length of the stems to the depth of the receptacle. Make artistic boquets of both autumn and spring wild flowers showing what colors harmonize. This is fundamental in creating good taste in clothing and household furnishings. What wild flowers are revived by the rainy season? What ones blossom after the snow is gone? What ones blossom before school closes? Put list on the board. Keep a wild flower calendar. Talk briefly about the conditions under which wild flowers grow. What is each child's favorite wild flower? Start a wild flower garden in one corner of the school yard.

Cultivated Flowers:- From conversations with pupils make a list on the board of all the different varieties of cultivated flowers growing around the various homes in the district. Find out a few things as to their care and value about the home. How many of these varieties are found on the school ground? When do these various flowers blossom? Are they grown from seed? Is it necessary to sow the seed every year? If not started from seed, then how? Test observation and interest by asking children to watch certain plants for a week and report all things of interest they may see. The detailed study of any flowering plant, wild or tame, should be left for

later years.

Harvest Festival:- The crowning event in the study of plant life during the year should be the exhibition in the school room of the best products of the field, orchard, garden and roadside. This, of course, should be participated in by the entire school. Thanksgiving is a good time for this expression of appreciation of the earth(s goodness. It is a means of grace for all the country side. Who can show the finest onions, potatoes, pears, walnuts, flowers, pop corn, pumpkin? "In all the range of vegetable products, I doubt whether there is a more perfect example of pleasing form, fine modelling, attractive texture and color, and more bracing odor, than in a well-grown and ripe field pumpkin. Place a pumpkin on your table; run your fingers down its smooth grooves; trace the furrows to the poles; take of its form; absorb its rich color; get the tang of its fragrance. The roughness and ruggedness of its leaves, the sharp-angled stem strongly set, make a foil that a sculptor cannot improve. Then wonder how this marvellous thing was born out of your garden soil through the medium of one small strand of a succulent stem". Bailry, The Holy Earth p. 109.

3. Animal Life Throughout the Year.

Common Domestic Animals:- Name animals on the farm that work for us. What does each one do? What does each animal eat? How are these animals housed? What constitutes a good barn, poultry house, etc? In what ways is the horse useful? Why can a horse do certain kinds of work better than any other animal? How is a horse trained to work? Discuss harness and its fitness for the horse. Mention all the things a horse needs every day. When does a horse need special care? In what way? Why do horses need shoes?

Discuss difference between the horse that pulls a heavy load and the one for the light buggy. If possible show pictures of various kinds of horses and ponies. In like manner make a somewhat detailed study of the dog. Each child to tell why the dog is a friend to man. Tell the various ways that a dog is useful on the farm. Show pictures of dogs. What does a dog like for food? Watch one eat. Tell how he does it. What kind of teeth has he? Children will enjoy some good stories of dogs.

Wild Animals:- What wild animals in the community? How do they live? Where do they spend the winter? What ones are injurious to the farmer? In what ways?

Birds:- Make a list on the blackboard of the birds present when school opens. How recognize different birds, - color, song, size, manner of flight, etc? What birds stay all winter? What ones return when spring comes? What is the food of birds? Where do they stay at night? Name various places where birds build their nests. Watch them building their nests, feeding the young and teaching them to fly. Keep a bird calendar noting when each bird is first seen. How are birds useful to us?

Insect Life:- Notice any insects found in connection with the garden or any plant life studied during the year. Describe them in a general way, giving size, color markings, etc. What are these insects called, their common names? What is the food of insects? How do they get their food? Perhaps by observation they may learn that insects are grouped into two general classes according to the way in which they get their food, viz:- the biting and the sucking. This knowledge is necessary so as to use the proper spray to kill the injurious insects. Spraying and a more detailed

study of the insects to be made in the upper grades.

4. Physical Phenomena and the Inorganic World.

Weather Calendar:- This should be kept each month noting days of sunshine or clouds, rain or snow, etc. Temperature, direction of the wind can be indicated. Also note changes of seasons. Why the days grow longer or shorter. What is the longest day? The shortest?

Sky Studies:- Where does the sun rise? Set? What direction is the sun from us at noon? What is meant by new moon? First Quarter? Full moon? Last Quarter? How does the moon shine? How often do we have full moon? Look at the sky on a clear night. What do you see? What is the "Milky Way"? Look for groups of bright stars. One group is called the Great Dipper. How many stars in this group? Can you see the two stars called the "pointers"? To what do they point? Why is it important to know the North Star? The positions of various groups of stars seem to change during the year. Watch for this and see if you can always locate the Great Dipper, and the North Star. Another bright group of stars is called Orion. He was said to be a mighty hunter. Have some one help you find him.

Rain:- What is it? How caused? What good does the rain do? What damage at times? How are clouds formed? What is a fog? How do hail and snow differ from rain? How many inches of rainfall in your district? What is a rainbow? Tell about the colors. Does the snow ever fall in your part of the state? If so, how deep does it get at times? What good do you think the snow does.

The Brook:- Appearance during the dry season. What change after the rain has fallen for a few days? Where does this particular brook have

its beginning? Its end? In what ways is the brook a busy worker? Under what conditions does it do the most work? The least work? What causes the difference in the color of the water? Are there any small stones or pebbles in the brook? Are they rough or smooth? Why? Bring out the thought of running water as a force in soil formation. Watch a section of the brook during one rainy season and report changes in appearance.

III- Outlines for The Third Grade.

Pupils of the Intermediate Grades, the Third, Fourth, Fifth and Sixth want to know more details. On page 40, review the references there given.

1. Human Needs, Interests and Activities.

Seasonal Activities:- First, Harvesting. When school opens discuss somewhat in detail the work that is being carried on to harvest the crops of field, orchard and garden. How does the yield compare with last year? How are prices? Any scarcity of labor? What is the olive crop worth in your district? Or the orange? The apple? Or whatever is the special crop? If only one crop is raised in a community, what would likely be the result if that crop should fail? What is a diversified crop system and its benefits? What is the last thing to be harvested in the fall? The first in the spring? What part do the children have in the harvesting process? Write on the blackboard a list of all things that are harvested in the district from August 1, to November 1. From April 1, to August 1. This will give a pretty good survey of the agricultural resources in the community so far as plant life is concerned. Second, Planting. What things are planted from August 1 to December 1? From December 1 to April 1? In field crops take wheat or alfalfa

and discuss the best methods in the preparation of the seed bed. Have children observe practices of best farmers. How deep should the planting be? Why? The work to be done preparatory to setting out an orchard or a vineyard? Third, miscellaneous activities as pruning, spraying, care of livestock, poultry, etc. In a measure better methods of work on the farm can be emphasized but the chief purpose is to magnify the importance of the farmer's work and to dignify honest toil in general. More detailed instruction and observation, of course, are left for the seventh and eighth grades.

Seasonal Needs:- Changes in weather related to human comfort as to food, clothing and shelter. Contrast requirements in July with those in December. The wisdom of "looking ahead" on the farm. Reasons why the farmer should plan for six months or a year in advance. Storage of food.

Social Interests:- The year's picnics, excursions, fishing trips, fairs, parties, patriotic celebrations, etc. What is the school doing to develop the social idea? Play on the school ground, social value. Meetings in the school house, their community value. Discussion of various institutions and organizations that are helping to give a better community life. Is there a rural church, a grange, a farm bureau in the district? Find out if possible their programs of work.

Health Needs:- Hygiene for the individual in the school and home and for the community at large. Refer to books on physiology for topics with reference to breathing, ventilation, the five senses, and first aid. Discussion of contents of some one bulletin from State Board of Health as to drainage or water supply, or the fly or the mosquito. Do not attemtp to cover the whole field of rural sanitation in this grade. Leave a few things for the upper

grades. Select some one phase and do as thorough work as is possible considering always the capability of the ones taught.

2. Plant Life Throughout the Year.

Garden Studies:- Each child make a list of all vegetables grown in the home garden. When were the seeds planted? Who helped in the summer garden work? What is the fall appearance of the home or school garden? Name vegetables that have been used or that are now ready for use. The same with flowers. What parts of vegetables are used for food? What ones are being stored for future use? Where and how? What seeds are collected for spring planting? What vegetables remain in the garden during the winter or rainy season? Discuss preparations for garden work in the spring. What fertilizer is best to use? How prepare the seed bed? Get a seed catalogue and discuss varieties. If not possible to have a little plot on the school grounds, encourage the home garden. In either case have a window garden in the school room. Plant a few quick growing vegetables as radish, bean, pea,to observe germination and growth. Have a flower box with geranium slips and nasturtium seed for a beginning. Plan for a school exhibit next year.

The Tomato:- Why a good plant for detailed study? In what ways valuable as food? Inspection of growing plant in garden with pupils if possible. Question on board for children to answer if not possible to inspect growing plant. Position of growing plant. Stems and general character of growth contrasted with other plants. Look for flower, color, different parts. Where is the flower found? What part stays on to make the fruit we eat? Name of this part? Have three or four ripe and green tomatoes of choice varieties in the school room to study characteristics that make a good tomato. Recall what

Bailey says about the "Admiration of Good Materials". Bring out points as to shape, color, firmness, smoothness of skin, thick, juicy meat, sweet flavor and few seeds. Make cross sections of both ripe and green tomatoes to notice seed arrangement. Discuss removing the pulp, washing out the seed and drying them. How store the seed for the spring planting. Plan to have a tomato growing contest at home. Exhibit of the best home grown tomatoes at the school Fair. Value of the tomato industry in the State. A brief report of a tomato cannery. Have children visited any kind of a canning factory? Tell what they saw.

The Morning Glory:- Begin to emphasize the climbing plants, their value about home and school and interesting things in their manner of growth. Children report all kinds of climbing plants they can think of. Take one as the morning glory for a type study. How can it grow so high? What kind of a stem has it? How does it hold on to things? Look at the leaves, telling how many on a stem and where do they grow? Why is this a good vine about our homes? Note the position of flowers, Where do the blossoms open? What does the bud look like? When does the morning glory begin to bloom? How long? Does a flower open more than once? Why are they called morning glories? Examine a flower that is just ready to bloom and one that is fading away. With specimens of the bud and flower in several stages of growth and green pods and ripe ones have children try to determine what part of the flower makes the seed. Open a ripe pod and describe all that can be seen. How do the seeds get out of the pod? Do we have to plant the seeds every so often in order to have vines, etc?

Wild Morning Glory or Birdweed:- This is a very noxious weed.

Certain phases of this plant may be reserved for study in higher grades. But in connection with the study of the tame morning glory certain points of resemblance may be noted in the wild morning glory.

The Milkweed:- This is a good plant to study to note how one kind of seeds are scattered. Where is the milkweed found? How high does it grow? What kind of stem and leaves? Color? Why called the milkweed? What has this plant been doing all spring and summer? What other plants are doing the same? When does the milkweed blossom? Describe the blossom. Where are the pods and how are they arranged? Carefully open a pod and describe all that you see. What is fastened to each seed? What is this for? Throw a seed into the air and watch the result. Count the number of seeds in a pod. Does the milkweed plant die in the fall? Dig up one to notice the roots. Do you think a plant with this kind of root would live from year to year. Drive a stake near one in the fall and then look for this plant in the spring. What is your decision? The seeds of plants like the milkweed are called fly-away seeds. Name other plants that have seeds like the milkweed. Ask the children shortly after school has opened to bring in specimens of fly-away seeds and start a chart of seed-fliers. They can doubtless bring in specimens of dandelion, scarlet geranium, thistle anyway. There are others. Bring in all different kinds and name them. Compare them. Some seeds have wings like maple-seed instead of the downy parachutes like the milkweed, etc. Any other seeds have wings besides the maple.

The Thistle:- Where do they grow? Are they alone or several together? How are the leaves arranged on the stem? Are they smooth, or hairy on one side or on both sides? Where are the spines, around the margin of

leaves or on the ribs and veins? Look at the edges of the leaves and tell what you see. How does the flower grow? Which open first, those at the top of the stalk or those lowest on the stalk? Do the row of flowers at the outer edge of the head open first or those at the center? Color of blossom? Any fragrance? What insects visit the thistle blossom? How are the flower heads protected? Carefully cut away the protection and note how the seeds are placed. Count the number of seeds in one head. Describe all that you can see about one seed. A small lens will help you to see some interesting things. Take one seed and put it in a warm, dry place, where it cannot blow away. How long does it take for the balloon to open up? What is the shape? Why is the thistle so hard to kill? What is the best way to kill it? What bird is very fond of thistle seed? In a general way bring out the fact that other plants have other ways of disseminating their seeds. The detailed study of these plants may be left for upper grades.

Wild Flowers:- Enumerate the wild flowers of the district or vicinity that are going to seed when school opens. Those that are in blossom during the autumn months. What are the prevailing colors of the autumn wild flowers? Of those that blossom during the spring? Collect wild flower seed for spring garden work. In fall and spring have wild flower blossoms in the school room. Teach pupils to collect a few only of each kind with as long stems as possible. Arrange in artistic mass effect in simple flower holders. Teach harmony of color. The same will apply, of course, to cultivated flowers.

Nut Trees:- Name all trees of orchard or forest whose nuts ripen in the fall. Have children appreciate more fully the life and work of trees

in general and the special value of nut trees for ornamentation and food. Bring samples of various nuts to school. If oak trees are near, bring in leaves as well as acorns. If the black walnut is available make a special study of it. Put a few questions for observation on the board and ask children to find the answers from observing some walnut tree. Is the tree tall or short? Bark rough or smooth? Anything peculiar about the furrows in the bark? Are the branches near the ground? Are they large or small? Is the bark on the branches of same color as that on the trunk? Watch in the spring to see if there are any flowers on the walnut tree. Is the wood of the walnut tree good for anything? Where do you find the nuts on the walnut tree? Do the nuts fall before the leaves? Describe a walnut. Where is the real seed that grows to make another walnut tree? Take a few twigs indoor for observation. Look for tiny buds for next spring, leaf scars, and rings showing the year's growth. Notice the kind of leaves the walnut has. If the black walnut is not in the neighborhood then take some other nut tree.

Seed Germination:- With the coming of seeding time in the locality, whether for garden or farm crops, the attention of the children should be called to the planting of seeds. What is a seed? What kinds are planted? Name all garden seeds that are usually planted at the close of the rainy season or the passing of snow. Teach the necessary conditions to grow seed, if in soil, the soil must be warm, moist - not wet - sunshine and air. If certain seeds are planted in wet cold ground, what is likely to happen? Make a cardboard chart showing best time to sow certain seeds. Children stick seeds in groups of two or three on chart and label. Use ordinary mucilage but not too much at a time.

Radish Seed:- Plant some in moist sand in a shallow box, keep moderately moist and warm, and dig up two or three from day to day to watch changes. Plant enough and have the box large enough so that some plants may make some growth. Or place seed between folds of damp cloth or blotting paper laid on a plate or saucer. Put in a warm place and watch the seed-leaves and rootlets put forth. As soon as the shell opens note how the seed-leaves or cotyledons are folded. Describe all you see. What is the appearance of the root? A further detailed study of the grown radish is left for an upper grade.

The Pea:- Allow a quantity of peas to stand in water for a day. Compare a soaked pea with a dry one. How do they differ and what has caused the change? Place a few dry peas in moist soil and see what would happen. Remove covering from soaked seed. This is seed coat. Note two thick pieces called cotyledons. What holds the cotyledons together? Discuss conditions necessary to grow garden peas, successfully. Encourage each child to prepare a small bed at home and plant some peas. Discuss value of peas as food. A lesson on the sweet peas can be given in connection with the study of common peas. Teach the soil conditions best for growth of sweet peas. If possible plant some on the school ground. Each child should be encouraged to grow some at home.

Tomato Seed:- A package of choice tomato seed should be planted in a box in the school room so that each child could have three or four plants to set out at home. Discuss what these seeds will need - as a box, some good soil, proper heat, light and moisture conditions. Discuss, when the time comes for transplanting, how the plants should be set out in the

ground. Show this by setting out a plant in the corner of the yard where the soil has been properly prepared. When the plants are two or three inches high in the box, they should be transplanted singly to small cans or pots and then later taken home by the children and transplanted again into the earth. If tin cans are used there must be holes in the bottom for drainage.

The Autumn Festival:- Before the school closes for the year discuss plans for the coming school fair. Get the cooperation of the parents during the summer vacation. Appoint the necessary committees. Urge each child and adult to exhibit the best of its kind. Let the committee on the arrangement of exhibits catch the spirit of the following:- "We all recognize the appeal of a bouquet of flowers, but we are unaware that we may have a bouquet of fruits. We have given little attention to arranging them or any study of the kinds that consort well together, nor have we receptacles in which effectively to display them. Yet, apples and oranges and plums and grapes and nuts, and good melons and cucumbers and peppers and onions may be arranged into the most artistic and satisfying combinations." Bailey, The Holy Earth.

3. Animal Life Throughout the Year.

Insect Life:- What butterflies are seen during the first few weeks of school? How do insects get ready for winter? Have children watch for caterpillars. Give all items of interest about them. How many feet? Color of head? How do they eat? What is their food? Put some in a pasteboard box and feed them. Watch for cocoons. Cut open one cocoon. What is on the inside? What insects are busy at work in the garden? Watch for spiders. Find a spider's web and report about it. What insects appear first in the spring? Where found? What ones are destructive to fruit orchards? How are

they removed? Have pupils see the difference between a biting insect and a sucking insect. Methods of control with reference to manner of getting food.

Bird Life:- What birds remain all the year? What birds destroy insects and worms on trees? How many have seen a woodpecker? Watch work and movements and report. Make a special study of the English sparrow if there be one in the vicinity, where it stays, feeds, disposition, etc. Try to identify different birds by their manner of flight. What is the food of birds during the winter time? Observations on nest building and care of the young. Make a bird calendar.

Domestic Animals:- Review work and worth of the common domestic animals on the farm as outlined in second year. The cat, why have one about the house? What is its food? What does it do? Describe eyes, ears, claws, etc. What are its whiskers? What are the wild relatives of the cat? Who has a dog at home? Of what use is he? Tell about his care, habits, wild relatives, etc. General study of hen. Where do they make their nests? Eggs, sizes and colors. Setting a hen. Chickens, their food care and enemies. Simple requirements of a good poultry house. Its care. Shelter for farm animals.

Wild Animals:- Name allffound in the community. What ones are injurious to cultivated crops? In what way? How exterminated. Make a special study of the squirrel or rabbit, food, manner of life, appearance, value, etc.

4. Physical Phenomena and the Inorganic World.

Weather and Temperature:- Study of the thermometer, its uses and how it works. Use of mercury and alcohol. Place thermometer in various

parts of the room and note the readings. Put a weather calendar on the board and on it record daily temperature of outside air from readings of thermometer hung on the outside of the school house for a few minutes. What is temperature? What makes weather?

The Moon:- Appearance when it is full? Difference in appearance between the new moon and the full moon and why. Where does the new moon rise and where does it set. Does moon rise earlier or later on succeeding nights? How does the moon give light? Discuss various phases of the moon.

Seasons and Rainfall:- Review all previous work with reference to change of seasons; causes of rain, value of rain. What are snow and ice and how caused?

Physical Phenomena:- Burning of wood and coal; Kerosene lamp; evaporation of water; wind as a drying agency on mud, etc; Cloudy days and nights contrasted with clear days and nights. Frost and its effect upon plant life; insect life: Effect of cold weather upon children.

Brook and Soil:- Review all previous instruction regarding the work of the brook and how soil is made.

IV- Outlines for the Fourth Grade.

Pupils of the Intermediate Grades, the Third, Fourth, Fifth and Sixth want to know more details. On page 40, review the references there given.

1. Human Needs, Interests and Activities.

Seasonal Activities:- Review in general as given in previous grades. Take some one field crop as barley, wheat and alfalfa and make a detailed study of processes and operations in raising the crop from the preparation of the soil to the final marketing of the crop. Have children

Seasonal Needs:- Review in general as given in previous grades. Take some one need as clothing or shelter and have children find out just how this need may be supplied, - factors, materials, labor, etc.

Social Interests:- The year's recreation activities. Plans and programs. Social and educational values. Games and play on the school grounds. Participation of children and relation of experiences. What institutions in the community are helping to give a richer social content to neighborhood life?

Health Needs:- Hygiene for the school and home and community. Personal responsibility of pupils. Refer to some good elementary text on physiology for material and rules for the promotion of good health. Good and bad teeth and their relation to health. Structure and care of the teeth. Use of teeth. Use of the toothbrush. Work of the dentist. Muscles, uses, movements, etc. Bones and their relation to muscles. Good positions of the body. Value of good habits in posture of body while young. Value and necessity of exercise. A health reader on the above topics may be used in class. Do good thorough work in this connection.

2. Plant Life Throughout the Year.

Garden Studies:- This is a necessary topic for every grade. Review studies of previous grades and get a new point of view of some more or less familiar phases of garden interests. How does the garden compare with previous years? What things of special interest during this year? Plans for home and school gardens. Study of seed catalogues. Mistakes made last year and measures to avoid them this year. Grow several varieties of radish and lettuce to determine the most desirable. Make out a list of

vegetables to be planted for the school exhibit.

Sweet Corn:- Examined seed. Discuss preparation of soil and best time to plant. Watch its growth and report when tassel appears; when the silk appears; height of stem, thickness, size of leaves, etc. Number of ears on stalk. Compare with pop corn or field corn if any is grown in the district. See list of varieties on page 51. Uses of sweet corn. Why used as human food? Discuss canning of sweet corn. Tell all the things that must be done from the time the kernels are planted to the time when the cans are shipped away. Damage done by the corn ear worm.

Sunflower:- Study entire plant as it is growing. Have pupils tell all they see. Go into details as to height, color, character of stem, leaf, flower. Look carefully at sunflower head at different stages of growth. Is the flower one or many? A small flower is called what? Each produces what? How many seeds in a head? Color and various uses of seeds? Where on the head do the seeds ripen first? Watch the bees on the sunflower head. What do they want and what are they doing?

Bulbs:- Have a bulb garden on the school ground if possible. Consult seed catalogue as to best time and methods of setting bulbs out. Consult list on pages 68 and 69 of bulbs which may be planted out doors in the fall for spring or summer bloom. Tulips, narcissus, daffodils and crocuses are good. Who in the community has been especially successful in bulb gardening at home? Have children find out how success was secured. Factors in success as proper location of bulb bed; character of soil; preparation of soil; use of well rotted manure; depth of planting; etc. The indoor bulb garden. Bulbs planted in boxes, pots or tin cans for blooming

indoor during the winter months. Discuss in detail how a bulb should be planted in flower pot. What bulbs are especially good for this indoor work. After planting why store away in a cool dark place? For how long? Remove one bulb and note root growth. Where do the roots start? Where does the stem start? How can a bulb make its early growth? Bring out fact that food is stored up in the bulb. Position of pots in school room and temperature during various stages of growth to secure the best bloom. Growing bulbs in water in the school room; how done; best bulbs for this purpose. Study of bulbs in the school room. Compare as to size, shape and color. Resemblance of bulbs to onions. What is a bulb? Cut one open. What is the arrangement on the inside?

Nasturtium:- Study of flower, stem, leaves and seed. Teach calyx - no. of parts, peculiarities, etc; Corolla - no. of petals, markings, nectar guides and spur; shape of lower petals, etc. Position of stamens when flower first opens. Length of filaments. No. of stamens. Anthers or pollen boxes. How many open at a time? The pistil and stigma. Where is the seed box? Changes in its appearance. No. of seeds. Color, etc. Pupils should be interested to study blossoms of the nasturtium at home to see how the insects carry pollen from one flower to another. Notice the special arrangement of the pistil and stamens to encourage cross-pollination. How do the flowers stand on the stem? Why? Study of characteristics of stem and leaves. How does the stem manage to climb? Interesting facts about the nasturtium. Why a favorite about the home?

Onion:- Have children bring into the school room a few large onions, onion seed, onion sets. What is an onion? Examine both ends and

discuss appearance. Outside covering of onion. What is its use? Cut onion open and notice layers. What are they? Testing of onion seed. Notice parts of seeds when germinated. Watch growth and report. Growing onions in the garden. Kind of soil needed, preparation of the seed bed. Various ways of growing onions. Onions for summer use; for winter use. Cultivation of onions. Study catalogue for culture hints and commercial importance of the onion crop.

Wild Flowers:- Review in a general way the studies given in previo grades. Make a special study of the California Poppy. Study parts as in case of the nasturtium. Kind of root, stem, leaves, flower, bud, blossom, parts of seed, pod, etc. Why a favorite flower? Have children discuss why wild flowers can send up blossoms so early in the spring or after the rainy season has opened? Dig up a few to show various kinds of underground stems as thick tubers, bulbs, and root stocks. As in the case of the onion and other bulbs food material was stored in these during last year's growth. Start a wild flower garden in the corner of the school grounds and discuss the care of the garden during the summer vacation.

Weeds:- What is a weed? Ways in which weeds are an injury. What are the common weeds of the community? How many of the list on pages 59-63 do the pupils know? Take one very common weed and find out about its root, whether a deep-boring tap-root; or a tassel-like root of many fibres also boring deep; or a spreading, many-branched but shallow-growing; or a creeping root-stock with underground buds. Stem, round, angled, or grooved? Solid or hollow? Rough or smooth? Hairy or woolly? Any spines? Strong or weak? What other peculiarities of stem? Describe leaves. How

arranged on a stalk? Are leaves smooth or rough? Character of edges? When does the weed begin to blossom? What kind of blossom has it? Describe the parts of the flower. How is the pollen carried from flower to flower, by insects or the wind? How do the seeds ripen, all at once or in succession? Many seeds or few? How scattered? What is an annual weed? A biennial? A perennial? Illustrations of each.

Evergreen Trees:- Why so called? Any growing in the community? See list on page 64. Pines as a group are characterized by needle-shaped leaves in clusters of two, three or five needles; by cones in which little seeds are borne; by wood which contains more or less pitch or resin. Special study of the Western Yellow Pine. Needles in threes, 5 to 10 inches long; color of cones and size; size of tree; character of bark: A few small branches in the school room to note arrangement of clusters of needles and attachment to branch. Determine a year's growth on the branch. Do the pines and other evergreens shed their leaves? How different from the elm or the apple tree in the manner of shedding of leaves? How are cones attached to the branch? How large are the seeds? How are the seeds scatte. Of what value is the wood.

Maple Tree:- Trunk smooth or rough, branches many or few, color of branches and trunk? How are the branches arranged; spread out or growing upward? Few or many twigs, straight or crooked? Shape of tree, round or wide at bottom and pointed at top like a pyramid, or shaped like an umbrella. On the twigs look for buds, scars and rings. How are buds arranged, opposite or alternate? Is there one at the end of the twig? What will this become? What will the side bud become? Watch growth of tree for answers. Watch for

flowers of the maple. Distinguish between flowers that have stamens and those that have pistils which develop into fruit and seeds. After the flowers have disappeared watch the development of seeds. How do the seeds get away from the parent tree? Of what advantage is this? Plant a few seeds in a box at school. Also plant a few in the ground at home. How long before the young plant begins to appear? How many leaves does the young plant have at first? Are the leaves like those of the big maple tree? Is the maple tree a good shade tree? Of what value is the wood?

Autumn Festival:- Plans for exhibition of best fruits of field, garden and orchard in the school house. Review general directions given in previous grades. Appoint committees before school closes in the spring. Endeavor to enlist the cooperation of the patrons.

3. Animal Life Throughout the Year.

Insect Life:- For help in insect study throughout the grades consult Essig's Injurious and Beneficial Insects of California - See list given on pages 53, 54, 55 and 56 of these outlines. Also get help from the County Horticulturist. Over forty counties now have such an officer. For this grade select one insect injurious to orchards, grapes and berries, garden, forage crops and ornamental plants. For illustration The Western Twelve-Spotted Cucumber Beetle (Essig, page 270). Watch for this insect in the garden. Describe its appearance. How easily recognized? Size. Search for its eggs. Appearance of the larvae. What is the life history of this beetle? How does it work? Where found? What plants does it eat? How control this pest? Give the spray formula. What natural enemies does it have?

Home Making Insects:- Bees, wasps, ants, etc. Make a detailed study of the honey bee. Watch the bees at work gathering pollen and nectar from the flowers. If possible watch them at work in the hive. Classes of bees. Life History. Care of bees.

The House Fly:- Kinds. The common house fly is black in color with five parallel, more or less distinct grayish bands on the back between the wings. No. of wings? Body and legs covered with what? Length of life of the fly? Breeding places of flies. Danger to health. How eradicate flies?

Spiders:- How differ from insects proper? Where are spiders found? What time of the year? Four general classes, web weavers, crab spiders, runninng spiders, jumping spiders. Endeavor to study one of each class. Look for webs. How many kinds? Names of spiders with reference to kind of webs - Cobweb weavers, funnel web weavers, filmy dome weaver, orb weaver. What is the difference in the appaarance of these webs? Try to observe a spider at work spinning its web. Use of the web? Food of spiders. Items of interest about the web. Where are the spinnerets?

Bird Life:- From list of California Birds given on pages 78---87 select three or four for detailed study noting size, colors whether bright or dull; special markings on head, back, breast, wings, or tail; general shape of body whether long and slender or short and stocky; character of bill, short, long, curved, hooked; wings short and round or long and slender; tail forked, notched, square, fan shaped; movements, hop, walk, creeping up trees, motions of body in various situations; manner of flight steady, direct zigzag, quick or slow, flapping, sailing, etc. Places where

the particular birds are found, fields, around the house, gardens, hedges, streams, etc. Food and how procured; character of song and call notes.

Wild Mammals:- See list on pages 89-94 of these outlines.

What is meant by wild mammals? What is meant by domestic or tame mammals? Name several of each class. Select a common wild mammal in the district and make a detailed study as to appearance; chief characteristics; habits; food; damage to crops; damage to trees; plants that it does not eat; natural enemies; methods of control by man.

Barnyard Fowls:- Different varieties or kinds of chickens, ducks, geese, turkeys.

The Turkey:- Special study. Difference in appearance of the male and female birds. Covering of the head of the turkey? Color and how far down the neck? What is the "wattle"? What is the "caruncle"? What are "the beads" on the neck? Color of the eyes? Where is the ear? Can a turkey hear well? Do turkeys scratch like hens? Describe feet and legs as to shape, size and color. Where do turkeys like to roost? Are they sound sleepers? Where do turkeys thrive best? What is their food? Why study the turkey in the month of November? How do turkeys fight? How does a "Gobbler" strut? How early in the spring does the turkey hen begin to lay her eggs? Describe the nesting place and the turkey hen's attitude towards visitors to the nest. How many eggs in the nest? Describe the eggs. Care necessary for the young turkeys. Are there any wild turkeys in the vicinity? Is turkey raising profitable?

4. Physical Phenomena and the Inorganic World.

Rain:- How caused? Inches of rainfall during the past year? Average rainfall for the locality. Forms of water, ice, steam, solid ice, liquid water, gaseous steam. Snow, Hail, Frost. Dew. Explain each. Distinction between "soft" water and "hard" water. Storing of ice. Manufacture of ice. Cold storage and use of refrigerators. Storage of water. Making of ice cream.

Stars:- Explain the term Constellation. Locate the Big Dipper or Great Bear. Distance of the stars. How fast does light travel? How far away is the sun? The moon? Polaris or the pole star. It is estimated that it takes nearly 50 years for the light of Polaris to reach the earth. If light travels 186,000 miles per second how many miles away is Polaris? Notice position of the Big Dipper at eight o'clock of an evening and then again at ten o'clock. In which direction are the Constellations moving? Locate the Little Dipper and the Dragon. Watch the positions of these three Constellations during various months of the year.

Thermometer:- Explain construction and use. Keep a daily temperature calendar for thirty days. Compute the average daily temperature.

The Sun:- Time of sunrise and sunset. The longest day in the year. The shortest. What is meant by "the sun crossing the line"? Meaning of equinoxes ? Solstices? How long does it take the light of the sun to reach the earth? How many days of cloudless sunshine in one week? In one month?

V- Outlines for The Fifth Grade.

1- Human Needs, Interests and Activities.

Vacation Activities:- Reports on condition of home gardens. What

garden crops have been harvested? What are soon to be ready for harvesting? Discussion of special things in connection with vacation work in the gardens. Preliminary report on proposed agricultural exhibit in the school. Work of various committees.

Farm Interests:- Survey of present crop conditions in the community. How many acres of Wheat, Barley, etc, have been harvested? What is the importance of the live stock interest? Are there any pure bred herds of dairy cattle? Have children gather data at home of a general agricultural interest and report.

Season Activities:- Describe the cutting of alfalfa; wheat; corn; etc. Special items of interest in connection with the orchard pruning; the best time for pruning and spraying. Consult the County horticulturist or the farm adviser for information as to latest phases of orchard management; crop operations; live stock; etc. If possible have children get topics for discussion at some farm bureau meeting. Insist that the school keep in touch with progressive agriculture in the community. Discuss best methods of preparation of seed bed for various crops.

Human Needs:- Make a list of the principal social, educational and recreational needs of the people of the community. What attempts are made to satisfy these needs? What is the farm bureau doing to satisfy economic or social needs of the farmer? Do farmers need money to develop their business? Is the church or the home making any special effort to satisfy wants and needs? In what way? What is the school planning for the year? Modern conveniences in the home. What do they cost? What is a sanitary home? How is the house cleaned? What devices may lighten labor? Find out what is being

introduced into the homes of the community? How is the farmer's work made easier? Labor saving tools on the farm. Materials of which various articles are made. Name the metals used in the construction of buildings and the manufacture of tools. Difference between steel and iron. How is steel made: What is aluminum? etc?

Health Needs:- It will be necessary of course during the year to review some of the previous years' work in physiology and hygiene. This year the emphasis may be placed on food and the digestive system and respiration and the organs of respiration. Any good elementary text on health primer may be used as a reader to supplement the regular reading material and thus furnish abundant topics for discussion. Plan to observe health day with a special program. How prevent diseases? Character of disinfectants. Care of the school drinking cups and the water jar. Value of good sunlight with reference to health. Condition of the outbuildings. Character of water supply in the community.

2. Plant Life Throughout the Year

Strawberry:- Reports on strawberry crop of the district. Are any grown for other than home use? Make list of questions for study of the strawberry plant, the children doing their observation work at home. Have one plant with runners in the school room when children make their reports. Verify the statements of children. What is peculiar about the blossoms of the strawberry plant? When set out strawberry plants? How are they set out? How cultivated? Do the plants die during the winter? What name is given to plants that live from year to year? In severe winters why are the strawberry plants covered? What is meant by the mulching of plants? What material

may be used for mulching? Does the entire plant live over winter?

Biennials:- Beet or turnip as a type. Each child bring a few beet seeds to school. Where did they get the beet seed? Has any one ever seen the beet in blossom? Get a good plump beet and plant it in a box. At the same time plant a few of the beet seed. In time the children will see that plants come from the beet root as well as from the seed. With the seed growing into plants and plants growing from the beet root throughout the season one may learn the life history of a beet. It takes two years for certain plants like the beet to go through all stages of life from seed to seed. Such a plans is called a biennial. Other biennials are turnip, cabbage, parsnip, carrot, salsify, etc. Which is the most important? Discussion of the sugar beet industry. Any sugar beets grown in the community or state?How is the ground prepared for sugar beets? Method of cultivation? How harvested. Description of a visit to the sugar beet factory. What is the value of biennials to man?

Fiber Plants:- Any cotton, hemp or flax grown in the community? If so, have a specimen in the school room for study. How is the fiber separated? Value of fiber. Manufacture and use of ropes, binding twine, etc. Count the number of strands in a small rope or binder twine.

Lawn Grass:- Name different kinds of plants used in making a lawn - Kentucky blue grass, white clover, Australian Rye grass, Bermuda grass, Lippia, etc. Dig up a small bunch, wash soil out carefully and note character of root growth. Notice small fibers and main root stock. Value of root stock during the dry season or winter. When rains begin what is the effect? Ways of starting some lawn grasses by seed and sod.

In a small box in the school room plant different seeds at varying depths and watch results. Talk with some one who has a good lawn and find out the various things to insure a satisfactory lawn. Best time to water and mow a lawn. Plant and insect enemies of a lawn and their control.

Dandelion:- Notice plant in various stages of growth. Does it live through the winter? Biennial or perennial? Notice arrangement of leaves on plant just appearing above the surface of the ground. Where are the oldest leaves? The youngest?Dig up plants and get entire root. Compare it with roots of blue grass or some other plant. Advantage of the long fleshy tap root? Compare with the California poppy in this respect. Pull the rosette or cluster of leaves apart and notice tiny flower buds. Study flower of the dandelion at different stages of growth, position, length of stem etc. When does the flower close? Is the flower a single or cluster? Compare with other flowers studied. Count the number of flowers on a single plant. If each flower makes a seed how many seeds will a single plant produce? What kind of seeds does the dandelion have? How are they scattered? What is the best way to exterminate the dandelion? Try cutting plants at different places, above the surface of the ground, at the surface, and various degrees below the surface.

Weeds:- From list given on pages 59-63, select one as the Wild Radish for example and make a detailed study using directions for studying the dandelion and directions given in previous grades. Contrast appearance, manner of growth, character of stem, leaves, flowers, seed and root of the wild radish with the dandelion or wild morning glory or milkweed or thistle. In this grade teach children to recognize three new weeds and study their

manner of growth and means of eradication.

Cultivated Flowers:- From list on pages 65-66 select one flower for study as the Petunia for example. Something about its early history, original varieties, colors. Development of petunias with variegated colors. Character of stem,why stems and leaves are sticky to the touch. Shape of leaves, thickness, etc. Parts of the flower - tubular corolla, no. of parts united; calyx with number of sepals; number of stamens and how attached; the pistil with reference to position of stamens. Is the petunia a self-pollinated flower or is it dependent upon insects? Where is the nectary and what kind of insects can get at the nectar? Watch a flower to find out. Describe the seed pod. Count the number of seeds. With a small glass note peculiar markings on a seed. Value of the petunia as an ornamental plant.

Wild Flowers:- From list on page 65 select two or three common in the community and make a detailed study of each noting their environment, time of blossom, etc. Use directions given on the petunia above and learn all the interesting things possible about the particular wild flowers under study.

Cultivated Vegetables:- From list given on page 58, 59 select one as the Turnip for illustration and make a detailed study somewhat after the manner of studying the beet and tomato given above. Emphasize the food value and manner of growing - preparation of seed bed, cultivation, enemies, harvest and storing, methods of cooking, etc.

Trees:- From lists given on previous pages of Ornamental, Forest and Fruit Trees, by observation, become acquainted in a general way with distinguishing characteristics of two or three illustrations of each class.

A detailed study of a particular tree is left for the sixth grade.

Autumn Festival and School Exhibit:- Review on pages 99- Admiration of Good Materials - page 109- Harvest Festival and page 120- The Autumn Festival.

3. Animal Life Throughout the Year.

The Pig:- General characteristics. Comparison of nose with nose of other farm animals. Why does it root? Describe its teeth, eyes, head. Does the pig have much intelligence? How are the ears placed on the head? How is its body covered? Habits and why considered a dirty animal? Natural food of the hog. What is fed to the hog on the farm? Describe the pig's foot. How many toes? How many used in walking? Can the pig swim? What noises made by the pig? Name and describe the principal breeds of pigs. History of hog (See Davenport's Domesticated Animals and Plants).

The Colt:- How old before it can run? What is the weight of a colt one week old? What care should a young colt receive? How teach him to lead? Importance of right training. Food of colt other than mother's milk. When are colts weaned? What kind of pasture is good for a young colt?

The Dog:- Origin. Why equipped with stronger legs than the cat? How do the claws of a dog differ from those of a cat? Describe a dog's feet. How many toes? Describe the dog's body. With what is it covered? What is the shape and color of a dog's eyes. Can the dog see in the dark? What about his ability to see and hear? What one of the five senses is most highly developed? Describe his teeth. For what different purposes are they used? How does a dog express his emotions? What noises does a dog make?

Why does a dog bay at the moon or howl when he hears music? Name the different breeds of dogs. What lead to the development of these different breeds? What is the best dog for the farm?

The Mouse:- What good things can be said of the mouse? Where does the mouse live? What kind of a home does it have? What is its food? What damage does it do? How does the field mouse differ from the house mouse? Identify and study the deer mouse and meadow mouse described on page 92. What enemies does the mouse have? What is the most humaneway of getting rid of Mice?

Fish:- Importance of fishing industry. If possible have a small fish in a large bowl of water in the school room. From observation here or fish in the stream have children try to determine how a fish moves through the water; fins used most; number of fins; how it eats and breathes? Can it see, smell and hear? From a visit or from reading describe a fish-hatchery. Value of fish as food. Kinds of fish. Any laws for the protection of fish? What are they? Accounts of a fishing trip.

Birds:- List of birds identified on the black board. Keep bird calendar. Make special study of seed eating birds. Study Western Meadow Lark (p. 83); Song Sparrow (p.84); White-Crowned Sparrow (84). Green-Backed Goldfinch (p85); California Towhee (85)

The English Sparrow:- When and why introduced into this county? Kinds of birds in a flock of English Sparrows. Describe the male sparrow; the female sparrow. Chief differences between the two. Coloring varies in vividness during different times of the year. Size of English Sparrow used as a standard to determine size of other sparrows and wild birds.

Habits. Food. Adaptation of beak to get food. Action of flock of English Sparrows feeding. Disposition. Why does it stay all the year? How does it treat native birds. Describe nest. Well or poorly built? Character of different notes. Under what circumstances different notes are used? In what ways is the bird a nuisance? Is it of any benefit? How discourage it from living around us? See page 84.

Moth and Butterfly:- Four different forms during life, viz:- Eggs. Larva, Pupa, Adult. Look for eggs in clusters or single, usually found on plant which is favorite food of young. The larva is the worm which hatches from the egg. This is the stage when the eating and growing is done. Pupa is the period when it rests or sleeps and wonderful changes take place. The adult is the full grown insect. Difference between Butterflies and Moths:- (a) body-Moth is stout, butterfly is slender; (b) Wings- Moth has wings folded flat along back when at rest, butterfly has wings erect over back when at rest; (c) Antennae - Moth are thread like or feathery, but never knobbed at the apex, butterfly has knobs at end of antennae; (d) Flight- The moth flies at night, the butterfly flies by day; (e) Pupa- Moth has pupa protected either inside coccons or by being underground or in some sheltered place, butterfly has a naked pupa attached by the tail end to a button of silk.

Cabbage Butterfly and Worm:- (Essig. Injurious and Beneficial Insects of California p. 455-457) Watch for butterfly in garden hovering over the cabbages. Describe appearance. How tell the male from the female? Size and color of eggs? Appearance of the worm; the chrysalis, find out. Life history of this garden pest. Nature of work of the caterpillars or

worms. Damage to cabbage. What other plants does the worm feed upon? Control both by spraying and otherwise.

The Devastating Grasshopper:- (Essig p.44-49. See also pages 32,33,38,39,40,41,42). Where are grasshoppers found? Watch movements. How many wings? Legs? Sizes of legs? Notice how under wings are folded. Use of outer wings. Watch movements of mouth when grasshopper is eating. Carefully dissect the mouth showing all the parts. Names of the parts. (See Comstock's Hand-book of Nature Study for Teachers- an invaluable help). Look on the head of the grasshopper for its eyes. How many? Describe the feelers or antennae. They are the organs of touch. Raise the wings and find the ears of the grasshopper. How many? How does the grasshopper make its music? Various kinds of grasshoppers. Describe the devastating grasshopper, color, spots on hind legs, wings, etc. Life history. How different from life history of the cabbage butterfly? Food plants of this grasshopper. Method of control. See Essig, p. 38 for control of short-horned grasshoppers or true locusts.

Mosquitos:- (See Bulletin No. 178, Mosquito Control, College of Agriculture, Berkeley). What do children know already about the mosquito and its habits? When are mosquitos most active? When and where do they rest? What do they eat? Most live largely upon juices of plants as they do not have a chance to suck the blood of animals. Only the females bite. Discuss life history. Breeding places; eggs, larvae or wiggle tails? How long does it take for the eggs to hatch? Position of larvae in water. Larvae of malarial mosquitos almost parallel with surface of the water. Larvae of common mosquitos beneath surface of water at an angle of about

forty-five degrees. How does the larvae breathe. Change of larvae to pupae. Description. Do the pupae move as did the larvae? How does the pupae breathe? Does it eat anything? Watch for the pupae skins from which have emerged the adult mosquito. Methods of control. See also Farmers' Bulletins No. 155 U. S. Dept. of Agriculture on "How Insects Affect the Health in Rural Districts."

4. Physical Phenomena and the Inorganic World.

Heat:- Chief source. Nature. How heat produces light? Difference between heat and light. Discussion of primitive fire-making. Modern way. Various ways of producing heat-friction, combustion, etc. Ways in which heat may be transmitted. Explanation of conductor and non-conductor. Application to kinds of clothing, weight, material, color, etc. Meaning of fire proof buildings. First aid for a severe burn. Meaning of "spontaneous combustion." Illustrations of action of heat in common affairs of life as pouring hot water into a glass dish.

Crystals:- Illustrations in nature. Examine ice and snow; surface of freshly broken rocks or minerals. How make crystals with common salt or with alum?. Blue vitriol is a poison yet it makes fine crystals. What is rock candy? What precious stones are crystals?

Rocks:- How formed? Explain granite, lava, slate, sandstone, limestone. Have specimens in the school room for a discussion on the origin of soil. Relation of rocks to the earth's crust. What is sedimentary rock? Look at small stones along the edge of a stream or in the dry bed. What are the various shapes? What has caused the changes? What are the fossils sometimes found in rocks? What

forces cause the decay of rocks? What are some of the common minerals found in rocks?

Air:- Different things that make the air. How deep or thick is the layer of air surrounding the earth? How heavy is the air or what is its pressure? Why do we not feel this pressure? What do we mean by the temperature of the atmosphere? How do we measure it? Why does the air get colder as we go up? What causes winds? Necessity of air for animals and plants. Air in soil and water. How is air made impure? Explain how carbon dioxide is made. What relation does oxygen have to combustion? How is nitrogen valuable to plant life? If the atmosphere at the sea level weighs 15 pounds to the square inch, and if four-fifths of this weight is nitrogen, how many pounds of nitrogen are pressing down on every acre of the earth's surface? What is meant by the expression, "millions in the air"?

VI- Outlines for the Sixth Grade.

1. Human Needs, Interests and Activities.

Silo Construction:- Number of silos in the community? Any in the process of construction? Children get data as to materials used, wood, concrete, brick, stone or steel. Method of construction. Size and shape of a silo. Children estimate the volume of a silo in pounds. Find out how many pounds of silage are fed daily to a cow. Estimate how long the silage in this particular silo would last for a herd of ten cows. Advantages of a silo. See Circular 138 of the College of Agriculture at Berkeley on "The Silo in California Agriculture" by F. W. Woll.

Correspondence Courses in Agriculture:- Through the pupils of the school make an agricultural education survey of the district to ascertain

how many are enrolled in the correspondence courses of the Division of Agricultural Education of the University of California. Send for circular describing the character of these courses. Many of these courses will prove of value to the teacher in the work of the seventh and the eighth grades.

Special Irrigation Problems:- Very valuable material for many rural schools in Bulletin No. 253 of the College of Agriculture at Berkeley entitled "Irrigation and Soil Conditions in the Sierra Nevada Foothills Well illustrated with photographs and diagrams. California"./ Text to be studied by the teacher and a series of questions placed on the blackboard the answers to which will be brought in by the children after observation and study of irrigation practices and soil conditions of the school district. This is a most important topic under human needs and interests in California agriculture.

Marketing Grain:- Methods of storing wheat, barley, etc. Changes in shipping conditions. The sack versus the bulk method. Items of cost in harvesting and shipping. See Circular No. 152 of the College of Agriculture at Berkeley entitled "Some Observations on the Bulk Handling of Grain for California". Teacher make out lists of questions for children to investigate at home. The bulletins mentioned above are not to be put into the hands of pupils. They furnish material for the teacher to emphasize in this grade and the two upper grades more the economic phase of agricultural nature study.

Recreational Needs:- Discussion of social activities of the neighborhood. Reports on community fairs, play festivals, picnics, fishing excursions, etc. How can the school house be made the social and

recreation center? Spirit and practical application of the California law in this regard.

Health and Sanitation:- General health of the community. Any epidemics because of contagious diseases or bad sanitary conditions? Drainage and water supply of the community. From an elementary text on physiology and hygiene make a special study of the eye. Parts of the eye. Muscles, glands, etc. Kind of light best for reading. Effect of bad light Weak eyesight and the need of glasses. How test the eye for deficiencies in sight? Supreme importance of guarding the eyesight of children. Character of light in the school room. Special study of Circulation and the organs of circulation. The blood, composition, etc. Keeping the blood pure. Dangers of diseases entering the body through the blood by infection. Sanitary importance of cleanliness. Individual drinking cups, the sanitary earthen water jar or the bubbling fountain. The skin, structure, and office of regulating the temperature of the body. Glands of the skin. Care of the skin. Appendages of the skin as hair and nails. Importance and care. Review food and digestion.

2. Plant Life throughout the Year.

Geranium Cuttings:- As soon as the rainy season opens well enough to prepare the soil plant some cuttings. Discussion of the part of the geranium to plant - old stem or new growth? Show how to prepare the cutting before placed in the earth. Some put the cuttings or "slips" in a box of sand in the school room where a better control may be had. Show how to place the cuttings in the sand. Discuss favorable conditions for growth as to moisture, light, temperature. Transplant to open ground when

cuttings are well rooted. Teach children how to transplant. After transplanting watch for new leaves. Children bring flower pots to school for cuttings to take home. Discussion of proper soil, drainage, etc for the potted plant. Teach children how to pot a plant properly. Consult some experienced gardener or housewife who has been successful. While the cuttings are in the box pull up one or two. Examine the end. Has a "callus" formed? What do you mean by "callus"? Experiments of placing a potted plant in different positions near the window to see the effect of sunlight upon growing plants. What other plants beside the geranium may be propagated by cuttings? Advantages of using cuttings instead of seeds - quicker results and sure to get same kind of plant as the parent.

Grape Cuttings:- Consult some one with experience either the County horticulturist or a successful grower of grapes to find out (a) Are cuttings employed very much to start new vineyards? If not, what ways are employed? (b) If so, when is the best time to make the cuttings? (c) From what wood or cane is the cutting made? (d) How many buds on a cutting and how arranged? (e) How is a cutting made? (f) When place the cuttings in soil or sand? (g) How long does it take for a "callus" to form? (h) When are the cuttings transplanted? (i) Method of permanent planting. Care of the vineyard. Methods of pruning employed. When pruning should be done? On pages 56 and 57 look over varieties of grapes, mentioned. What varieties fit the particular locality of the school? Children report on cultural methods, diseases or injurious insects and commercial importance of different varieties. Samples of different varieties studied in the school room.

Grafting:- Find out the various practices among orchardists in

the district. What guiding principle or principles in grafting? Common example of English Walnut upon native black walnut stock? Have school report all other examples. Best time to graft? Best method of grafting? Advantages of grafting?

Budding:- Meaning? To what extent practiced in the community? When to bud? Discuss method of budding. Advantages.

Demonstration of Propagation:- If possible make arrangements with the County horticulturist, the farm adviser, or a successful local gardener or fruit grower to visit your school on some Friday afternoon and give a practical demonstration before the children of all the best ways of plant propagation. This need not be limited to the sixth grade but should come before the entire school considered as a single class.

Fruit Blossoms:- Study blossoms of all common fruit trees in the neighborhood. Shape of bud? Where placed on the twig? Describe bud and bud scales? What changes as bud expands in the bud-scales? Do leaves and flowers come from the same bud? Difference between leaf bud and fruit bud? On what growth of wood are flower buds borne? What are the scars seen on twigs? Notice a bud ready to open. Length of its stem? Describe calyx. Are sepals entirely separate or joined? Where united? Number of sepals? Describe the open blossom. Number of petals? Shape of petals? How attached? Color of petals? Number of stamens? How attached to the flower? Length of stamens? Color of anthers, pollen and filaments? Number of pistils? Describe the stigma, color and position with reference to anthers? Do fruit blossoms close at night? Any insects about the blossoms? Their importance? When petals fall, what is left? What part of the flower develo

into the fruit? What happens to the sepals or calyx? When is the best time to spray the blossoms? Study the buds and blossoms of the apple as a type and then compare all points with blossoms of the peach, cherry, prune, pear, plums, apricots. How many of the fruit trees listed on page 75 are grown in the local district? When in doubt about some of the details in blossom study consult the county horticulturist. Have your name on the mailing list of the State Commission of Horticulture at Sacramento to receive the Monthly Bulletins issued free. Ask the College of Agriculture at Berkeley for copies of all bulletins on fruits of California. Build up a reference library in the school.

Study of the Apple:- Shape in different varieties. Are any two apples of the same variety exactly alike? General characteristics of a particular variety as to shape; color markings of the skin; character of skin whether tough or delicate, etc. Value of the skin? Why care in packing for shipping? Notice carefully the stem end and blossom end of the apple. What are the withered points at the blossom end of the apple? Position in different varieties of apples? Cut open an apple. Notice texture of the fleshy part. Locate and describe carpels. Cut an apple across midway between stem end and blossom end and note the five-pointed star. What four here? Describe the apple seed. In either portion of the apple thus cut across locate the "core line." Identify the bundles of fibers extending through the center of the apple from stem to basin. How many? Identify the second "core line" in the cut-open apple. Can you see ten faint dots in the cross section of the apple? What are these dots? Discussion of the value of apples as food. Various ways of cooking. Methods of storing and

marketing. What different varieties of apples grown in the neighborhood?

The Potato:- Make a brief potato survey of the community to ascertain the importance of this particular crop locally. Any grown on a large scale commercially? No. of acres. No. of bags sold last year. Price per bag. Shipped away when dug? Any stored and methods of storage? Does each family grow enough for food? Bring a few potatoes to school, varieties of each, kind grown in the district. Study variety types and characteristics Is the potato a seed? If not, what is it? Why say "seed" potatoes? Discuss the "eyes" of the potato. How is the potato a part of the stem? If so where are the buds? Cut a potato in two through one of the "eyes". Describe and sketch cross section. Compare with cross section of a thick branch of a tree. Make the Iodine test for starch of the potato. Put two or three potatoes in a box of sand, moisten properly, keep in proper temperature and light and direct children to record daily observations. Plant the whole potato or cut it in pieces? Practices of potato growers of the community. Have children make observations of the best methods of preparing the seed bed for potato planting. Discussion in class. Rotation of crops valuable for the potato patch. Why? How plant potatoes? Insist on careful statement of all details. Various methods of cultivation observed and reported on. Arrange that each child large enough may have a few choice potatoes for seed and start a potato growing contest at home, the best of the yield to be exhibited, at the school fair. Each pupil keep a careful record of this home project in potato growing, viz: size of plat; no. of potatoes planted; the variety; method of preparing the soil; when and how planted? Dates when plants first appeared above the ground; when the tubers were big

enough for use; when potatoes were finally dug? Special treatment for insect pests or diseases. With class study the potato flower; color and position on the stem; color of flowers of different varieties. Any other plants have flowers similar to the potato flower? Compare with the tomato flower. Discuss the formalin treatment for potato scab.

Weeds:- Why successful plants? Make lists of weeds according to place where they grow - (a) Garden (b) Cultivated fields. (c) Pasture. (d) Lawn and vacant lots. (e) Roadside. Group these same weeds as to life into (a) Annuals. (b) Biennials. (c) Perennial. On pages 59-63 select three weeds not studied thus far and discuss environment as to soil, moisture, climate, relation to other plants, etc. Recognition of weeds. General form of plant. Characteristics of stem, leaves, root, flower, seeds, habits of growth and manner of seed dispersal. Methods of eradication. See Shaw's Weeds and How to Eradicate Them; Weed's Farm Friends and Farm Foes, Part I, Farmers' Bulletins No. 138, Weeds used in Medicine; No. 279, A Method of Eradicating Johnson Grass; No. 660, Weeds and how to Control Them (List of 50 Worst Weeds).

Trees:- How many of the trees listed on pages 63-65 are found in the vicinity of the school? Bring twigs into school room and study buds, leaf scars, rings of growth, etc. Sketch twigs showing everything. Describe the different parts of a tree. Comparison of parts in different trees. How recognize trees by shape of leaf and color of bark? How do trees reproduce their kind? How do trees breathe? How do trees grow? How do trees feed? Best methods of planting trees? Value of trees? Trees and forestry. The spirit of forestry. Value of the small woodlot at home. See Jepson's Trees

of California; Comstock's Handbook of Nature Study for Teachers; and Roger's Among Green Trees.

Garden Work:- Plan for the home vegetable and flower garden. Study seed catalogues. Discuss what to plant in the way of annuals and biennials.

Fall Festival:- Make necessary plans for the annual school fair and harvest home festival. Study artistic arrangement of fruits, vegetables and flowers.

3. Animal Life Throughout the Year.

Insects:- (Reference, Essig's Injurious and Beneficial Insects)

Codlin-Moth:- (Essig p. 436-438). Study in connection with the apple. Description of eggs, larvae, etc. Life History; Nature of work; food; control, when to spray, etc? Children make observations in orchards and report.

Other Insects:- In like manner study San Jose Scale (Essig p. 179-180); Walnut Aphis (Essig p. 82-83); Squash bug (Essig p. 202-203); Potato tuber Moth (Essig's p. 446-447); See also Monthly Bulletins of the State Horticultural Commission.

Birds:- As tree protectors. From list given on pages 78-87 select for study those birds that especially feed on insects as Red-Shafted Flicker or Yellow Hammer; California Wood pecker; Western Meadowlark; Bullock Oriole; Black-Headed Grosbeak; Western Warbling Vireo; California Bush-Tit; Western Blue-Bird. For helps in teaching see list of books and pamphlets given on pages 88-89. Classify birds as to permanent residents, summer residents, winter residents, migrants.

Geese:- General appearance. Chief differences between a goose and a duck as to bill, length of neck, legs, wings, walk, flight. Examine track of goose, How different from track of the duck? When are geese "picked"? Why? Describe in shape and color the Toulouse, the Embden, the African and the Chinese geese. How many found in the school district? Describe food of geese; nest and eggs. What name given to the young of geese Describe in general appearance and covering. How do the old take care of their young? How does a goose fight? What care does a goose take of her body? Stories of geese as to their intelligence, etc.

Sheep:- Any in the district? What kinds? Are they "Mutton" or"Wool" Sheep? Meaning of terms? Study habits of sheep. Describe the mouth How many and what kinds of teeth? How can a sheep eat the grass so closely? Are sheep allowed in the forest reservations? Why not? Enemies of the sheep? How does a sheep fight? Hearing and seeing of the sheep? Describe a young lamb. Name the principal breeds of sheep? Whatare the chief things that distinguish a sheep from other animals? What are the chief qualities of a good shepherd and his dog? Where was the original home of the sheep? How does a sheep differ from a goat?

Wild Mammals:- Study habits of California mole; California Coon; California Skunk; and California Pocket Gopher. See descriptive matter on pages 89-93. In addition to helps mentioned on page 94, consult Comstocks Handbook of Nature Study for teachers for valuable suggestions and practical helps. Write to College of Agriculture and U. S. Department of Agriculture for Bulletins. Above all else, set the children to watching these animals to discover their manner of life.

4. Physical Phenomena and the Inorganic World.

Weather:- Work of the weather Bureau of the U. S. Department of Agriculture in relation to farm interests. Weather Maps. Get copies for several successive days and with a wall map of the United States learn how to read the weather map. Meanings of areas of high pressure and low pressure. What do the arrows on the map indicate? Meaning of isobars? The movement of a storm. Character of clouds, winds and changes of the barometer and thermometer. Meaning of a cyclone area and an anti-cyclone area? What is a cyclone? How does the air move in a cyclone area? In an anti-cyclone area? Enumerate the weather conditions during the passage of a cyclone. Weather signals of the Bureau, storm warnings - uses of flags, whistles, etc. References:- Waldds Elementary Meteorology, Davis' Elementary Meteorology and Bulletins from the U. S. Weather Bureau.

Barometer:- Study in connection with weather map, etc. How is a barometer made? Use of mercury. How high is the column of mercury at the sea level? What is the pressure of air at this point? How is the barometer useful in measuring heights of mountains, etc? Actions of the barometer to indicate fair or foul weather. Review the thermometer.

Light:- Meaning of the term "self-luminous"? Give illustrations of self-luminous bodies in nature. What is a "luminous" object? Give illustrations. How do light-rays travel? Which travels the faster, light or sound? Give proof of your answer. What is the velocity of light per second? Of sound? How long does it take light from the sun to reach the earth? How long does it take to reach the earth from the nearest fixed star? Why does a spoon appear broken when placed in a tumbler half-full of water?

Why can we see ourselves in a mirror? Meaning of diffused light and why it is best for our eyes? What is the sun-dial? Brief description of the solar spectrum and explain the meaning of the seemingly meaningless word "Vibgyor". Effect of sunlight on plants? On life in the home and the school room?

The Brook:- Study of a small stream and its work. Beginning and end of this particular brook? Character of course and why? Character of its banks at various places. Difference in open country from wooded region. Meaning of the "work" of a brook? With what tools does it work? When does a brook "play"? Causes of difference of color of water at various times? Fill a fruit jar with the muddy water of a brook and allow to settle. What is the result? Look at the pebbles in a brook and along its banks. What do you find? Why are some very smooth? Explain sedimentation and erosion from study of the work of a brook. Find a delta. See Miller's, The Brook Book and Frye's, Brooks and Brook Basins.

Soil:- Surface of earth covered with rock. Agents that helped to break up the rock crust. Work of glaciers, water, winds, air, etc. Expansion and contraction through heat and cold. Samples of sand, gravel, small pebbles, clay and garden soil in the school room. Explanation of humus. Action of bacteria. See Fletcher's "Soils" for the story of the formation of the soil.

VII. Outlines for the Seventh Grade.

"In the seventh and eighth grades the work may well take on a more decided agricultural trend. At the same time it should be based upon the underlying principles of science. Hence the methods employed should be similar

to those used in the lower grades; that is, the work of observation and handling of objects must be continued. In no other way can the work do for the pupils all that it is capable of doing."

"It is most sincerely hoped that the observation work will be carried on in these grades even if a text book in agriculture is used. A book can never take the place of actual hand to hand contact with real objects. It may be profitably used to supplement the work of observation." From Lesson Plans for Teachers in Nature-Study Agriculture by Patterson and Dexheimer.

1. Human Needs, Interests and Activities.

Vacation Activities:- Reports from pupils as to the home garden projects.

Calendar of Farm Operations:- Discuss methods of keeping an account of the farm operations by months during the coming school year. Enumerate the principal agricultural activities of the community.

Crop Survey:- Reports on present conditions of the various crops, yields if harvested, climatic, moisture and soil conditions. Each child bring a list of estimated yields, of various crops on his father's ranch. How much sold? Amount consumed at home? This to include garden, field, orchard, and livestock. Problems of marketing.

Needs:- Special irrigation or drainage needs. Soil needs. Market needs, transportation needs, educational needs, etc.

Processes:- Pupils write out in detail the successive steps in the production of one crop from the preparation of the seed bed to the final disposition of the product. State importance of each step. Describe all tool

used. Estimated cost of production. Net revenue for the farmer. Is farming a paying business? Why? For valuable material see circular No. 12[illegible] Some Things The Prospective Settler Should Know issued by College of Agricul University of California.

Social Interests:- Plans for community betterment. Work of the farm bureaus in a social way. What is the Grange doing for the Social life of the farm? The Improvement Club or a Woman's Club? Plans of the Parent-Teachers' Association. The school in play and recreation. The play festival in the community. How organize one? Program of play. See Curtis's Play and Recreation in the Open Country.

2. Plant Life Throughout The Year.

Corn:- See list of varieties on page 51. See Correspondence Course on Corn Culture, College of Agriculture, University of California for material suited to California conditions. What varieties of corn are grown in the district? How many acres grown? Its use. Study of a plan in detail. Get a green plant. Characteristics of the root system. Kinds of roots. Depth and direction of growth of roots. Name all important details. of the stem. Nodes and internodes. Study a cross section of the stem. Arrangement of fibers. Work of fibers. Leaves, number and arrangement, how fastened to the stem, etc. Work of the leaves. The two flowers on the corn stalk. How placed on sweet corn? On milo maize? Review parts of flower in nasturtium, pollination, etc. How do these apply to the corn plant? Office of the tassel? Of the silk? How many silks on an ear of corn? What must happen before a grain of corn is formed? Explain cross-pollination and self-pollination. Explain fertilization method in the corn plant. Improvem

of the corn plant by selection and breeding. Uses and history of corn. Valuable material on the origin and improvement of plants and animals may be found in Davenport's Domesticated Animals and Plants. See also Bulletins from the U. S. Department of Agriculture and a good text in elementary agriculture.

Wheat:- Extent of wheat raising in the district? In the state? Past importance of the wheat crop in California. Do we now raise enough in the state to supply state needs? Why? What has caused the decline of the wheat industry? What kinds of wheat raised in the district? What other varieties besides those listed on page 51? Samples of different kinds in the school room. Look for weed seed. What constitutes a well-prepared seed bed? When is wheat sown? Ways of sowing it. Study of wheat plant. Characteristics of stem as contrasted with stem of corn plant. Identify petiole and blade of the wheat leaf. How joined to the stem? Note position of leaves along the stem. Are leaves parallel veined or netted veined? Study root system. What is meant by a "fibrous" root system? What other kind? What other common plants have characteristics common to wheat so far as stem, leaves and root are concerned? Study of the head. Why called a spike? Note and describe rachis, spikelet, glume. If wheat is bearded which glume bears the beard? Number of grains in a spikelet. Study of the flower of the wheat plant. Compare with flower of the corn plant. Ways of improving the wheat plant. History and uses of wheat. See Davenport's Domesticated Animals and Plants and Patterson and Dexheimer's Lesson Plans for Teachers in Nature-Study Agriculture.

Weeds:- See list on pages 59-93 which of these are specially

troublesome in the corn field? In the wheat field? Which are annuals? Biennials? Perennials? Which are most successful? Best method of combating each? Study these weeds in the fall when flower and seed are available. Study one weed in detail as to height, color and character of stem; method of branching; kind and manner of leaves; appearance of leaves on different parts of plant. Describe the flower. Where are the seeds? Appearance? Estimate number of seeds on a single weed. Name several things that make weeds successful plants. Study other weeds noting like and unlike features, to one already studied. In what ways are weeds injurious to growing crops? How are weeds injurious to animal life? Ways of scattering weeds? Collections of weed seeds in small vials with proper labels. See references at close of outlines on Weeds in the Sixth Grade.

Alfalfa:- Discussion of legumes in general. Name other legumes besides Alfalfa. Note habit of growth of alfalfa. Characteristics of stem leaf and flower. Study of the root system. Kind of root and its advantages. Locate tubercles or nodules. What are they? What are the bacteria and what do they do? Where do the bacteria get the nitrogen? How many pounds of nitrogen in the atmosphere over every acre of ground? Value of alfalfa as a feed. Its value in a rotation system of cropping? Why? See "Alfalfa Culture" in Circular No. 121, Some Things the Prospective Settler Should Know and Correspondence course in Alfalfa Culture, both from College of Agriculture, University of California.

Garden Crops:- On pages 58 and 59 Study Carrot, parsnip, Beans and Beets according to following general outline. (a) Brief History. (b) Cultivation as to soil preparation, seeding and harvesting. (c) Improvement.

(d) Uses. (e) Enemies. (f) Home projects for pupils. See Wickson's California Vegetables, Circular 121 mentioned above (for bean culture); Consult Seedmen's Catalogue for culture hints and variety descriptions. Last but not least consult successful grower in the community, one who has experience in local climatic and soil conditions. Commercial value of vegetable growing. Economic importance of fresh vegetables in the home. Food values of vegetables studied.

Ornamental Shrubs:- From lists on pages 66 and 67 study five native ornamental shrubs and a like number of exotic ornamental shrubs. How do shrubs differ from trees in the habits of growth? Emphasize the use of shrubs in masses on school and home grounds. The ABC's of landscape arrangement. Draw designs on the blackboard and study arrangement of shrubs. Consult landscape division, College of Agriculture, University of California for planting plans for school grounds employing trees and flowers as well as shrubs. See Hall's Studies in Ornamental Trees and Shrubs.

Ornamental Flowers:- From list given on page 66 study five annuals and a like number of perennials according to suggestions given in outlines in previous grades. Emphasize landscape effects in plantings. Build up in children an appreciation of the more attractive environment of school and home. Teach correct principles of arrangement. See McLaren's Gardening in California. Landscape and Flower; Braunton's The Garden Beautiful; and Wickson's California Garden Flowers, Shrubs, Trees and Vines.

Wild Flowers:- From lists given on pages 65 and 66 study five annuals and five perennials. See Payne's California Wild Flowers and Native Shrubs and Trees; and Parson's Wild Flowers of California.

Vines:- Find out what the pupils already know about vines in the community. Put list on the board. How many recognized of lists on pages 67 and 68. Study in detail three deciduous and three evergreen vines from that list. Classify as to annual or perennial. Where plant vines? Of what value in an ornamental way? See references given under ornamental and wild flowers above.

Ornamental Trees:- Discussion on ornamental trees of the district. How classify them? Make list on blackboard. Which are native? Which are brought in from other states or countries? How to become acquainted with a tree? What special things to be noticed? How distinguish one tree from another? Comparison in trees of general outline, method of branching, color of bark, outline of leaf, arrangement of leaves and twigs, value of tree for shade, etc. See Jepson's California Trees and Roger's Getting Acquainted with Trees.

Fruit Trees:- General survey of the fruit trees of district. Number and kind of each. Study one each of the list of fruit trees given on page 75. Make a special study of the apple tree if that is the most important fruit tree in the district. Take the pear if that is more important. Have a successful grower give a short talk to the school on some Friday afternoon on new problems in growing a particular fruit. Get assistance of the county horticulturist or the farm adviser. See bulletins from the State Horticultural Commission; Circular 121, Some Things the Prospective Settler Should Know (pages 40-63); and Wickson's California Fruits and How to Grow Them.

Arbor Day:- When? What the day means? Spirit of Arbor Day.

How to plant a tree that will live? The best arbor day program for a school which has no trees, shrubs, vines or flowers on its grounds. Character of the program usually given at such a school.

Harvest Home Festival:- Best of the garden, orchard and farm with reference to vegetables, seeds, grains, fruits, grasses, flowers, etc., on exhibition in the school room. Study artistic arrangement. Cultivate the appreciation of good materials mentioned in previous grades.

3. Animal Life Throughout the Year.

Insects:- Study of insects in the seventh and eighth grades to be made in connection with plant study as far as possible. The success of a particular crop, may, to a great degree, depend upon a single insect in its environment. The plant life in any locality must guide in the selection of insects for study.

Grasshopper:- Review outlines given in the fifth grade. Make a more detailed study of the grasshopper as a type of the biting insect. See Comstock's Handbook of Nature Study for Teachers, for valuable material on the detailed study of the grasshopper and insects in general. See always Essig's Injurious and Beneficial Insects of California.

Cottony Cushion Scale:- Description, life history, work, control, etc. See Essig pp. 108-110.

Black Scale:- Essig p. 153, 154.

Grape Leaf Hopper:- Essig p. 432.

Squash Bug:- Essig pp.202, 203.

Harlequin Cabbage Bug:- Essig pp. 200, 201.

Alfalfa Caterpillar:- Essig. pp. 458-460.

Beneficial Insects:- Not all insects are injurious. On page 56 select two for study as the lady-bird beetle and the honey. Consult Essig's Injurious and Beneficial Insects and Comstock's Handbook of Nature Study for Teachers.

Birds:- General discussion of birds. See Outlines of previous grades. Review of main characteristics of birds already studied. See lists pp. 78-87.

Valley Quail:- Description, habits, food, protection.

Killdeer:- Characteristics and how beneficial to agriculture?

Western Mourning Dove:- Habits, food, etc. Why beneficial to agriculture:

Western Red-Tailed Hawk:- Description, habits, food, etc.

Sparrow-Hawk:- Study of characteristics and how beneficial to agriculture.

Chickens:- General discussion of the poultry interest in the district. Value of chickens on the farm. Different kinds of poultry in the district. Characteristics of each breed. Food of chickens, housing, incubators, brooders, etc. Diseases of chickens. Marketing of poultry products. Detailed study of the hen; the leg and toes; wings, feathers and arrangement; parts of a feather; manner of eating and drinking; sense organs, etc. For detailed information about the hen and bird life in genera see Comstock's Handbook of Nature Study for Teachers. For help on care of poultry see correspondence course in Poultry Husbandry, College of Agricultur University of California. See also bulletins U. S. Department of Agricultur Washington, D. C. No. 237 Poultry Management; No. 64 Geese and Ducks; No. 51

Standard Varieties of Chickens; No. 236 Incubators; No. 200 Turkeys; No. 225 Poultry House Construction.

Wild Mammals:- Study California Ground Squirrel; Chipmunk; Gray Squirrel. See descriptive matter on page 93. See also suggestions in outlines on mammals in the sixth grade.

Hogs:- General discussion of the swine interest of the community. How many ranchers keep hogs? Description of the different breeds? How many breeds are found in the community? Care of swine. Food. Diseases. Value for food. Importance as a farm animal. See circular No. 151, Feeding and Management of Hogs, College of Agriculture, University of California.

4 Physical Phenomena and the Inorganic World.

Heat:- Importance in agriculture. Review thermometer. Sources of heat. Methods of heating houses. Effects of heat upon solids, liquids and gases. Work and heat. Principles of expansion and contraction. See Rowell's Elementary General Science Book I. Also Holden's Real Things in Nature.

Sound:- How caused? Sound waves. Difference between sound and music. The voice. How is sound carried? Velocity of sound. Compare with light. If there were no ear to hear would there be any sound?

Electricity:- Elementary discussion of how generated, use of batteries, etc. Relation to telegraph, telephone, railway, etc. Possibilities of electricity on the farm, lighting, cooking, etc. The dynamo and the gasoline engine.

Sky Studies:- Recognition of a few of the most important and common constellations of stars. Movements and phases of the moon. Record of

time of sun rise and sun set. See Ball's Starland and Pratt's Storyland of Stars.

Weather:- Conditions, changes, etc. Review all previous work on this subject. Especially emphasize the work of the Weather Bureau of the U. S. Department of Agriculture.

Atmosphere:- Review all previous work. Especially emphasize composition, weight and pressure. Review barometer. Storms, winds, etc. Applications of pressure of air in practical affairs of life as the pump, vacuum cleaner, air brakes, etc.

VIII- Outlines for the Eighth Grade.

1. Human Needs, Interests and Activities.

Roads:- Study of the public highway as a need of the community life. Condition of the roads in the district. How many roads? How did the roads happen to be where they are? Relation of old trails to present system of roads. The United States land survey and roads. Methods of securing new roads today. Principal features of State Highway law. Material of which better roads are made. Methods of making better roads. Grading and drainage. Width of roads. Bridges. Use of concrete, road tools and implements. The maintenance of good roads. Taxation and bond issues. Trace California highway system on road map of the State. Social, educational and economic value of good roads.

Crop Survey:- What are harvested during the year? Make a list of crops grown in the community. Yields on various farms. Highest and lowest acre yield of the same crop. Average yield throughout the district. How many fields grow more than one crop in a single year? Pupils work out

an agricultural map of district showing different farm crops, location of pure bred herds of cattle, etc; silos; canning factories; kinds of orchards; fruit exchanges, etc.

Sanitary Conditions:- General study of health conditions of community as to water supply and drainage. Relation of certain insects to health. Means of protection. Local health board and its duties. Contagious diseases and regulations. Relation of bacteria to tuberculosis, diptheria, scarlet fever, etc. Discussion of simple but effectual disinfectants. Sunshine and hot water in the school and at home. Relation of school to community and personal hygiene. Principal state regulations with reference to pure food, pure milk, etc.

Farm Machinery:- General discussion of value of machinery in general. Kinds of power used in operating farm machinery; the gasoline engine and its uses. Reasons for the use of improved machinery on the farm. List of different tools used on the farm in the preparation of the soil for the crop. Make a special study of the development of the plow and its place in the progress of the human race. How does the plow compare in importance with the sword? List of tools used in the seeding of crops; tools used in cultivation. Discuss in detail the evolution of harvesting machines from the reap hook to the combined harvester. Also the machines used in haying of whatever kind. Describe special machinery for special crops as rice, beans, etc. Send to large implement houses for catalogues of farm machinery. Study these catalogues. Economic importance of proper care of farm machinery. Average length of life of a plow, a mower, a reaper. Money invested in farm implements on each farm. The total for

the district. Estimated loss each year because of poor care of machinery. What is proper care of a farm tool? Tools used in marketing products of farm as wagon, automobile, etc. Care of fruit boxes and milk cans. The repair shop on the farm and list of repair tools. Brief discussion by teacher of machines in accordance with the six fundamental simple machines, viz: the lever, the pulley, the wheel and axle, the inclined plane, the wedge, the screw. Pupils encouraged to find illustrations of uses of these simple machines in the economy of the home and the farm.

Seasonal Activities:- Summary of steps in various processes in farm operations , best methods as accepted by majority. Disputed points in various processes as pruning fruit trees; cultivation of orchards; irrigation; care of swine and poultry; filling the silo; use of cover crops; returning organic matter to soil as disposal of straw after wheat and beans have been threshed; conserving soil moisture, etc.

Home and Vacation Projects:- Discussion and planning of the home project as potato contest; bean growing contest; tomato contest; poultry contest, etc. etc. Results to be shown in connection with the community fair at the school house.

Social Interests:- Activities of the various forms of the institutional life of the community, as the grange, farm bureau, farmers' club, women's club, church, home and school. Value of lectures, concerts picnics, play festivals and various other healthful forms of recreation, The school house as the center of social and recreational interests. Work of a Home and School Association. Cooperation of extension activities of the State College of Agriculture.

2.Plant Life Throughout the Year.

Forage Crops:- Meaning of the word "forage". Classes, as the small grasses, the large grasses, the legumes, root crops, etc. Study in detail as many as possible of the forage crops listed on page 52. Review blue grass. The larger grasses include corn, Kafir corn, sorghum. Review study of common or Indian corn and then compare with Kafir corn. Note well the difference in the flowers of the two kinds. Value of Kafir and sorghum. See good elementary text in agriculture. Review what was outlined on alfalfa or legumes. Make a study of two other legumes as cowpeas and soy beans. Under miscellaneous forage plants are root crops for feeding to live stock as turnips, rutabaga and beets. Study of such as are grown in the district. Discuss feeding value. Why increased attention is being given to the raising and feeding of root crops, especially in a dairy region. Bailey's Cyclopedia of Agriculture is a valuable reference work for the seventh and eighth grades. Also Davenport's Domesticated Animals and Plants.

Plant Communities:- Character of a plant. How it grows. Parts of the plant. Work performed by each part. Factors necessary for plant growth. The environment of a plant. Tendency of plants to form communities. What is a plant society? What determines a plant society? Children investigate and report on plant communities in the garden; the orchard; the lawn; the barn yard; the public road; the woods; the various crop fields, as wheat barley, alfalfa, corn, etc. Plant communities may include weeds, wild flowers, useful plants, etc.. Reports on all plants found growing together as if to make a community. Notice insect life found in connection with the plants. To what extent can man control a plant

community? In this connection review all that has been studied about weeds, the characteristics as to successful plants. Give as much time as possible in this connection to review the important things about the various garden, field, orchard, ornamental and wild plants studied the previous years.

Additional Plant Study- Oats:- Characteristics of stem, leaves and roots. Meaning of the "oat panicle". Review outlines on wheat plant. Compare various points in the wheat plant with the oat plant. Value of oats for food. Why is oats considered a balanced ration for work horses? Uses of oat straw and wheat straw? Why is it regarded bad husbandry to burn straw after grain is threshed out? What is a better way? Diseases of the oat plant. Smut and the treatment. What is smut? Its damage to the oat crop.

Barley:- In like manner make a study of the barley plant.

Seeds:- Study of characteristics and identification of grass seeds as timothy; Kentucky blue grass; orchard grass; Australian Rye grass. The legume grasses as alfalfa, clovers (red, alsike, sweet, Burr.) Study samples of the various grass seeds sold to find percentage of adulteration with weed seeds. Get data from farmers, the farm adviser or the county horticulturist. Any law against selling adulterated grass seeds? What kinds of weed seeds usually found in grass seeds? Study of grain seeds as wheat, oats, barley, etc. Selection of seeds for planting- what determining factors? Improvement of crops through seed selection. Importance of the germination test before putting in the crop. Parts of a seed. See Farmers' Bulletins, U. S. Department of Agriculture.

Moulds, Yeasts and Bacteria:- Why important? Help to destroy.

Help to prepare some foods. Help to spread disease in plants and animals. Help in keeping up the fertility of the soil. See Corm's Moulds, Yeasts and Bacteria and Comstock's Handbook of Nature Study for Teachers.

Plants and Seeds as Sources of Foods:- Food in the apple, the bean, the potato, wheat, etc. Various food materials found as starch, oil, sugar, proteids, etc. Raw materials used by the plant to make foods. Sources of? Meaning of an element? Of a chemical compound? Illustrations. The ten elements that are absolutely necessary to grow a plant. See Patterson and Detheimer's Lesson Plans for Teachers in Nature-Study Agriculture pp. 152-156.

Orchard Problems:- Study of special problems of the orchard whether pruning, spraying, cultivation, harvesting, fruit, etc. Keep in touch with discussions in current farm and horticultural papers and bulletins issued by the State Horticultural society and the State College of Agricultur.

Human and Social Importance of Plant Life:- Development of an appreciation of a more attractive environment. Materials for beautifying school and home grounds. The simple elements of a good landscape design. Actual participation by children in planting and caring for things planted.

The School and Community Fair:- Always an annual event. The opportunity to show achievement in the art of agriculture. The educational and economic values of developing an admiration for the best products of the soil.

3. Animal Life Throughout the Year.

General Review of Animal Life on the Farm:- Review outlines given in previous grades. Teach additional facts using the following outline as a guide.

I. A Community Live Stock Survey.

1. Pupils gather data as to

a. General live stock interest.

b. Special breeds.

2. Value of live stock on the farm.

3. Relation to various kinds of farming.

II.General Brief Study of the Farm Animal as to History, Breeds, etc. Identification by pictures or otherwise.

A. Horses.

1. Draft.

2. Coach.

3. Speed.

B. Cattle.

1. Beef.

2. Dairy.

C. Sheep.

1. Fine Wool Breeds.

2. Medium wool breeds.

3. Long wool breeds.

4. Which of above are mutton breeds?

5. Characteristics of a good shepherd.

D. Swine.

1. Lard hogs.

2. Bacon hogs.

3. What is the biggest problem in connection with hog raising.

E. Poultry.

1. Chickens, - Fowls.

a. Egg - Type.

b. Meat-type

c. General purpose.

d. Ornamental.

2. Turkeys.

3. Geese.

4. Ducks.

III. Needs of Farm Animals.

1. Proper food .

2. Proper care and management.

IV. Feeds and Feeding.

1. Food required to

a. enable the animal to grow.

b. enable the animal to do its proper work.

c. create a reserve supply of energy or life.

2. Elements of food for animal life.

a. Water.

b. Mineral matter.

c. Nitrogenous matter or protein - muscle making

d. Fat- Carbohydrates - heat giving.

3 Factors in feeding.

a. Character of the feed.

b. Need of the animal.

c. Qualifications of the person who does the feeding.

4. Kinds of feeding-stuffs.

a. Coarse fodders as alfalfa, corn stover, etc.

b. Succulent foods as roots, etc.

c. Concentrates.

(1) Grain as corn, barley, oats, etc.

(2) By-products of manufacturing as bran, middlings, gluten, oil-meal, beet pulp, etc.

5. The balanced ration.

6. The nutritive ration.

V. Care and Management

1. Shelter.

2. Cleanliness.

3. Ventilation.

4. Exercise.

5. Rest.

6. Training.

VI. Diseases of farm animals.

1. Prevention.

2. Restorative.

VII. The improvement of animals.

1. Selection of ideal type.

2. Choice of parents.

3. Objects of breeding.

4. The pedigree.

5. "Pure Bred" or "Well Bred" versus the "Scrub".

Dairying as a special study:-Economic importance of the dairy cow to the farm, the farm home and the nation. The different pure bred dairy herds in the district. Good points about each. Three means of increasing the efficiency of the cow, viz: better care, better feeds and feeding and better breeding. Two tests for efficiency, viz: use of milk scale for quantity of milk and use of Babcock test for quality of milk. Sanitary production of milk. Study of new state law in this regard. The silo construction, value and character of silage, etc. The cream separator and the creamery. Butter and cheese making. Various uses of milk. The best dairy cow in the community. The best dairyman. Why? Value of dairy products sold in the community.

Special Study of the Hen:- Economic importance of the hen to the farm and the nation. Better care of the farm hen.
The best laying hen in the community. Care of young chicks. See correspondence courses on Dairy Husbandry, Swine Husbandry, Sheep Husbandry, and Poultry Husbandry, College of Agriculture, University of California.

4. Physical Phenomena and the Inorganic World.

Soil:- Review work of previous years as to origin of soil, different types, etc. The following outline is suggestive for a more detail study. See bulletin No. 242 Humus in California Soils, College of Agricult Berkeley. Also see some good text in Elementary Agriculture, See soil data in Circular 121, Some Things The Prospective Settler Should Know, College of Agriculture, Berkeley.

I. ---Character of the Earth's Crust.

II.-Agencies in Soil Formation.

III. Physical Processes in Soil Formation.

IV. Chemical Processes in Soil Formation.

V. Successive Steps in Evolution of Soil.

VI. The Major Soil-Forming Materials.

VII. Rocks as Soil Formers.

VIII. General Classification of Soils.

IX. General Physical Constituents of Soils.

X. Leading Types of Farm Soils.

XI. Humus in Soils.

XII. Soil Water.

XIII. Soil Air.

XIV. Soil Temperature.

XV. Cultivation of Soil.

XVI. How Maintain Soil Fertility.

XVII. Importance of Crop Rotation.

Physical Phenomena:- Review previous grades and emphasize any new data that has direct relation to agriculture.

UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE

DIVISION OF AGRICULTURAL EDUCATION

TEACHERS' COURSE 100 - Elements of Agriculture, Nature Study and School Gardens.

O. J. Kern, Asst. Professor Agricultural Education

Part II - The Home Garden and Vegetable Growing Project.

Outline Questions and References on:-

6-15-'18.

THE HOME GARDEN AND VEGETABLE GROWING PROJECT.

The following outlines are for the guidance and instruction of students and prospective teachers of agriculture in the country school or the school of the village and small town. In such communities land is available and land is needed to grow plants.

The matter that follows is expected to give knowledge of the material suitable for the instruction of the seventh and eighth grade pupils in home gardening and vegetable growing.

The practice work for students is a vegetable garden on the campus of the University of California. A successful garden has been maintained during both semesters of the regular sessions of 1915, 1916, 1917, 1918 and the Summer sessions of 1915, 1916, 1917.

No apology is deemed necessary for the use of the question instead of the brief topical statement. The use of the question makes possible the definite assignment for study. The use of the direct searching question that causes the pupil to think has long been considered one test of the ability of a teacher. The teacher's skill is not complete, however, until the thought provoking question results in clear, clean-cut, definite statements in good simple English from the pupil. Likewise the student and prospective teacher must read the reference that is supposed to answer the question in the outlines. Then two results, at least, must follow; 1st, the restatement of the subject matter by the reader with supplementary discussion, if necessary, by the instructor; 2d, actual garden practice on the campus, students and instructor working out together the problems of plant growing and soil management.

There is omitted here all classroom discussion of the Project, its

nature, kinds, administrative features, pedagogical values, etc., etc. The projects are limited to productive vegetable growing in the pupil's home garden, with the possible exception of the sugar beet. No improvement or "experiment" project is given unless the potato improvement outlines may be so considered. The great need for California boys and girls is to become acquainted with the common vegetables and to become skillful in growing the choicest varieties. Climate and soil are in their favor. The factor lacking is educational direction.

The animal project and the improvement project are reserved for later treatment.

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THE HOME VEGETABLE GARDEN.

A - The home garden may, in a measure, be a "school directed" garden. At least there should be cooperation between the teacher and the parent, the school and the home. The school garden, as commonly understood, may serve, if conditions on the school grounds are favorable, as a demonstration plot to teach the boys and girls certain processes that are fundamental to the success of the home garden. If conditions on the school grounds are absolutely unfavorable for any kind of soil and plant work, then perhaps a small plot may be secured on ground near the school building. All that follows is from the viewpoint of teaching the country child or the child of the village and small town where a small piece of ground is available if it is available anywhere. A vacant lot in a city, controlled by the school, is a most valuable laboratory equipment of the school, to teach boys and girls by actual participation, certain things they must know to have a successful backyard vegetable garden. And while the school garden, per se, is not treated in this connection, yet the treatment that follows on the home garden, for the teacher, will apply to the school garden, except perhaps in certain administrative features. The teacher does not manage or discipline the pupils in their home garden work. Leave that to the home. But if the teacher believes in garden work as an economic and educational project and has enthusiasm and can impart some of that enthusiasm to boys and girls, there will be no need of discipline, as understood in the schoolroom, whether in the school garden or in the home garden.

B - References:

1. Wickson, The California Vegetables in Garden and Field (Page references are for third edition).
2. Bailey, The Principles of Vegetable Gardening.
3. Correspondence Course in Vegetable Gardening, by S. S. Rogers, College of Agriculture, University of California.
4. Farmers' Bulletin No. 818, The Small Vegetable Garden, U. S. Dept. of Agriculture.
5. Farmers' Bulletin No. 937, The Farm Garden in the North, U. S. Dept. of Agriculture.

6. Farmers' Bulletin No.934, Home Gardening in the South, U. S. Dept. of Agriculture.
7. Farmers' Bulletin No. 856, Control of Diseases and Insect Enemies of the Home Vegetable Gardon, U. S. Dept. of Agriculture.

C - Outline Questions:

I - The Present Status of Home Vegetable Gardening in California.

1. How many homes in your locality grow their own vegetables wholly or part?
2. How many buy their vegetables?
3. How many buy their principal vegetable supply in the form of canned goods?
4. What reasons are given why homes do not grow their own vegetables?
   a - Wickson, p. 20.
5. What reasons have you heard?
6. How many reasons are valid?
7. Do people on specialized farms have time to grow a small vegetable garden?
8. How increase the interest in the home vegetable garden? (Answer: One way is by the training of children through the public school).

II- Advantages of the Home Vegetable Garden.

1. What is the hygienic benefit of fresh grown vegetables?
   a - Wickson, p. 23.
   b - Farmers' Bulletin No. 934 (Bottom page 3).
2. What is the economic benefit of home grown vegetables?
   a - Wickson, p. 24.
   b - Farmers' Bulletin No. 937, p. 3.
3. What is the social benefit of home gardening?
   a - Wickson, p. 25.
   b - Correspondence Course, Lesson 14, p. 7.
4. What are the benefits to growing children from practical training in soil and plant lore?
5. How is the vegetable garden an element of success in California agriculture?
   a - Wickson, p. 25 (The Garden in Mixed Farming).
6. What is the "crowning need of California agriculture"?
   a - Wickson, p. 26 (bottom of page).
7. Will agricultural education in the public school help in supplying this crowning need?

III - The Essentials of Home Gardening.

1. What three requisites for success in gardening?
   a - Wickson, p. 21.
2. What are the essentials of all gardening?
   a - Farmers' Bulletin No. 818, p. 3.
3. How important is the "human element", the gardener?
   a - Bailey, p. 6 (top of page).

IV - The Location of the Home Garden.

1. Where will you place your garden?
   a - Correspondence Course, Lesson 14, p. 8.
2. What things are to be considered in locating a home garden?
   a - Wickson, p. 99.
3. - When possibility exists for a choice of several locations, what considerations should determine?
   a - Farmers' Bulletin No. 818, p. 3.
   b - Farmers' Bulletin No. 937, p. 4 (Bottom of page).

V - Plan of the Home Garden.

1. What will determine the size of your garden?
   a - Correspondence Course, Lesson 14, p. 8.
   b - Bailey, p. 31.
2. Will you make a diagram of your garden plot?
   a - Farmers' Bulletin No. 818, p. 6, 7.
   b - Farmers' Bulletin No. 937, p. 5, 6, 7.
   c - Farmers' Bulletin No. 934, p. 4, 5, 6.
3. What is the first consideration in planning the arrangement of your garden?
   a - Farmers' Bulletin No. 937, p. 7 (Bottom of page).
   b - Farmers' Bulletin No. 934, p. 7.
   c - Wickson, p. 101 (Arrangement for horse work).
4. How are the ease and efficiency of cultivation made possible in garden planning?
   a - Bailey, p. 31.
5. Will you grow your vegetables in long rows?
6. What advantage in irrigation with the long row system?
7. What objections to the old practice of growing vegetables in beds?
   a - Bailey, p. 31, 32.
8. How may the garden diagram serve as a record?
   a - Correspondence Course, Lesson 14, p. 9.
   b - Farmers' Bulletin No. 818, p. 6.
   c - Farmers' Bulletin No. 934, p. 7 (bottom of page).
9. In planning succession of crops, what important considerations must be kept in mind?
   a - Farmers' Bulletin No. 934, p. 8.
10. What is meant by succession of crops?
11. What is meant by rotation of crops?
12. What is the importance of the rotation of crops?
    a- Bailey, p. 93 (bottom) p. 94.
13. What are the possibilities of succession and rotation in California gardens?
    a - Wickson, p. 120, 121, 122.
14. What will be the succession of crops in your home garden?
15. What vegetables will you plan to grow?
    a - Farmers' Bulletin No. 934, p. 7 (middle of page).
    b - Farmers' Bulletin No. 818, p. 8, 9.
    c - Bailey, p. 35 (bottom) and page 36.
16. What is meant by companion crops?
    a - Correspondence Course, Lesson 14, p. 9.

17. What skill is involved in growing home vegetables?
    a.- Bailey p. 4.

VI - Soil for the Home Garden.
1. Is ideal soil necessary for success in home gardening?
    a - Wickson, p. 40.
2. What extreme variations of soil are not best for gardening?
    a - Wickson, p. 40 (bottom of page), 41.
3. What soils are naturally excellent for gardening?
    a - Wickson, p. 41.
    b - Bailey, p. 82, 83.
    c - Farmers' Bulletin No. 937, p. 4.

VII - Improvement of Soil for Gardening.
1. How improve the adobe soil of California?
    a - Wickson, p. 45 (Important).
2. How improve light, sandy soils of California?
    a - Wickson, p. 46.
3. How improve a good, natural loam soil?
    a - Farmers' Bulletin No. 818, p. 15.
4. What is a good test to determine when garden soil is ready to work?
    a - Farmers' Bulletin No. 818, p. 14.

VIII - Manures and Fertilizers for Garden.
1. What is considered the best all round fertilizer for the home garden?
    a - Farmers' Bulletin No. 818, p. 16.
    b - Farmers' Bulletin No. 937, p. 9.
    c - Bailey, p. 93.
2. What is the best way to preserve stable or barnyard manure in California?
    a - Wickson, p. 92.
3. What is the best way to handle manure for gardens in California?
    a - Wickson, p. 93 (top).
4. What is a compost and how made?
    a - Wickson, p. 93.
5. If manure is not available, what then?
    a - Farmers' Bulletin No. 937, p. 9.
6. What commercial fertilizers may be used?
    a - Farmers' Bulletin No. 818, p. 16.
    b - Farmers' Bulletin No. 934, p. 17.
7. When will commercial fertilizers fail of good results?
    a - Farmers' Bulletin No. 934, p. 17 (bottom of page).
8. What is the value of wood ashes?
    a - Wickson, p. 96?
9. When is the use of lime advisable?
    a - Farmers' Bulletin No. 937, p. 10.
10. When should lime not be applied?
    a - Farmers' Bulletin No. 937, p. 10.

11. How may lime be applied?
    a. Farmers' Bulletin No. 937, p. 10.
    b. Wickson, p. 45.
12. Is lime a fertilizer?
    a. Farmers' Bulletin No. 818 (bottom of page).
13. When should commercial fertilizers be applied?
    a. Bailey, p. 99 (bottom of page).
14. What cautions in regard to the use of commercial fertilizers?
    a. Wickson, 97, 98.
    b. Bailey, p. 96 (middle of page).
15. After all, what is the easiest, cheapest and best thing you can do to enrich your garden soil?

IX - The Preparation of the Seed Bed.
1. What is tillage of preparation?
    a. Bailey, p. 88.
    b. Wickson, p. 79.
2. What should be the character of such tillage?
    a. Bailey, p.38.
    b. Farmers' Bulletin No. 818, p. 4.
3. When is the best time to begin the preparation of the soil?
    a. Wickson, p. 79.
    b. Bailey, p. 88 (bottom).
    c. Farmers' Bulletin No. 937, p. 8.
4. What are the immediate things for soil preparation?
    a. Wickson, p. 80.
    b. Farmers' Bulletin No. 934, p. 15, 16.

X - Seeds for the Home Garden.
1. What are the four general qualities of good seed?
    a. Bailey, p. 122.
2. When should seed be ordered?
    a. Farmers' Bulletin No. 818, p. 8.
    b. - Farmers' Bulletin No. 937, p. 11.
3. How much seed will you purchase?
    a. Farmers' Bulletin No. 934, p. 15.
    b. Farmers' Bulletin No. 818, p. 8.
    c. Any good, reliable seed catalogue.
4. Will you test your seeds?
5. What are the three leading tests of seeds?
    a. Bailey, p. 143.
6. What is a good, simple way of testing seeds?
    a. Wickson, p. 124 (top).

XI - Seed Sowing in the Garden.
1. What are the two things necessary for the germination of seed in the garden?
    a. Bailey, p. 155.
2. What are five things to be done to secure favorable moisture conditions for germination?
    a. Wickson, p. 125, 126, 127.

3. What is the importance of seed covering?
   a. Wickson, p. 125, 126.
   b. Bailey, p. 160 (bottom).
4. When and why should the soil be "firmed" over seed?
   a. Wickson, p. 126.
   b. Bailey, p. 155 (bottom).
5. What is "soil opening" and its importance in the germination of seed?
   a. Wickson, p.127.
   b. Bailey, p. 156.
6. How valuable is "mulching" where seed are sown?
   a. Wickson, p. 127.
7. How may irrigation be used to secure germination of seed?
   a. Wickson, p. 127.
8. What considerations determine the best time for sowing seed in the garden?
   a. Farmers' Bulletin No. 818, p. 16, 17.
   b. Bailey, p. 161.
9. What is a good garden calendar for your locality?
   a. Wickson, p. 110, 111, 112, 113.
   b. A successful local gardener.
10. What constitutes good "practice" or the "mechanics" of seed sowing?
   a. Farmers' Bulletin No. 818, p. 21 (bottom).
11. When will you thin your plants?

XII - Growing Plants for the Garden.

1. What is the advantage of growing indoors certain plants for the garden?
   a. Wickson, p. 128.
2. What is the most practical device for use by the home gardener for growing indoor plants?
   a. Farmers' Bulletin No. 934, p. 9.
   b. Wickson, p. 128.
3. How prepare the flat or seed box?
   a. Farmers' Bulletin No. 934, p. 9.
   b. Wickson, p. 128, 129.
   c. Farmers' Bulletin No. 818, p. 10, 11.
4. What is the arrangement that comes next to the seed box (or flat) in simplicity?
   a. Wickson, p. 129, 130.
   b. Farmers' Bulletin No. 937, p. 14.
   c. Farmers' Bulletin No. 818, p. 12.
   d. Farmers' Bulletin No. 934, p. 11.
5. What is the hot bed and when important?
   a. Wickson, p. 130, 131.
   b. Farmers' Bulletin No. 937, p. 12, 13.
   c. Farmers' Bulletin No. 818, p. 11.
   d. Farmers' Bulletin No. 934, p. 10.
6. What are the five objects to be attained in the management of a hot bed? (and seed box or flat)?
   a. Bailey, p. 72 (bottom of page).
7. What are the six things to avoid in such a management?
   a. Bailey, p. 72 (middle of page).

8. How should seedlings be handled that are grown by artificial heat or protection?
   a. Wickson, p. 134.
   b. Farmers' Bulletin No. 937, p. 17.
9. What is meant by the "seed bed" in the garden as an aid to earliness?
   a. Farmers' Bulletin No. 937, p. 14, 15.
   b. Farmers' Bulletin No. 818, p. 20.

XIII - Transplanting.

1. What are the two fundamental considerations in successful transplanting?
   a. Bailey, p. 187.
2. What important points to be observed in transplanting?
   a. Wickson, p. 135.
3. What should be done before the plants are moved from the flat or hot bed?
   a. Farmers' Bulletin No. 937, p. 17 (middle of page).
   b. Farmers' Bulletin No. 934, p. 13.
   c. Farmers' Bulletin No. 818, p. 21 (bottom).
4. When is the best time to transplant?
   a. Bailey, p. 188.
   b. Farmers' Bulletin No. 813, p. 22.
5. How should the plants be set?
   a. Bailey, p. 189.
   b. Wickson, p. 135.
   c. Farmers' Bulletin No. 934, p. 14.
   d. Farmers' Bulletin No. 818, p. 22.
6. What vegetable plants may be transplanted directly from seed sown in the garden row?
   (Answer: Onions, lettuce, beets, kohlrabi, etc.)
7. How transplant these either to "fill in" a row where the seed did not come or plant a new row?
   (Answer: No material difference from directions given above).

XIV - Cultivation.

1. What is meant by tillage of maintenance?
   a. Bailey, p. 91.
2. What is tillage to conserve moisture?
   a. Wickson, p. 80.
3. What is the importance of the earth mulch in California?
   a. Wickson, p. 81.
4. What are the three steps by which conservation of moisture is attained?
   a. Wickson, p. 82, 83.
5. What are some of the tools of tillage?
   a. Bailey, p. 111, 112, 113, 114.
6. What are the hand tools ordinarily used in the home garden?
   a. Farmers' Bulletin No. 937, p. 25.
   b. Farmers' Bulletin No. 818, p. 13, 14, 15.
   c. Wickson, p. 83.

7. What is the importance of the "man with the hoe"?
   a. Wickson, p. 83, 84.
8. What is the importance of deep cultivation in California?
   a. "There is little grace, we admit, in the attitude of the Italian market gardener, as he straddles the row, arches his back and grunts as he sends his heavy mattock its full depth into the soil around the plants. The American with his fine, new, full-width, bronze-shanked, green-labeled, steel hoe, marching along the rows, touching the soil with disdain as ill worth exertion on his part, is a much handsomer picture. But the Italian's plants laugh at drought. When irrigated the soil takes water like a sponge and it goes plump down to the roots of the plant. Irrigate the shallow-hoed plot; a pailful will run a rod and the plant root gets but the gurgle of the water as it flows along the surface of the hard-pan just beneath the dust." Wickson, p. 85.
9. How are ridging and hilling as forms of cultivation used?
   a. Wickson, p. 86, 87.
10. What is the importance of flat cultivation in California?
   a. Wickson, p. 87.
11. What is the most practical method of irrigating your home garden?
   a. Wickson, p. 65.
12. What are the seven important things that must be done by the successful gardener without waiting for suggestions from anyone or consulting an almanac for the phases of the moon?
   a. Wickson, p. 108, 109 (Very important).
13. How are weeds a mere incident in gardening?
   a. Bailey, p. 196.
14. When are weeds "constants" in gardening?
15. What are eleven ways of keeping weeds in check?
   a. Bailey, p. 197, 198.
16. When are weeds a compliment to your garden soil?
   a. Bailey, p. 198.

XV - Garden Diseases and Insect Enemies.

1. What are some means of prevention?
   a. Farmers' Bulletin No. 856, p. 4, 5, 6.
2. How make Bordeaux Mixture and for what used?
   a. Farmers' Bulletin No. 856, p. 6, 7.
3. How make Formaldehyde Solution and for what used?
   a. Farmers' Bulletin No. 856, p. 8.
4. How make Kerosene Emulsion and for what used?
   a. Farmers' Bulletin No. 856, p. 8.
5. How prepare Lead Arsenate and for what used?
   a. Farmers' Bulletin No. 856, p. 9.
6. How prepare Nicotine Sulphate and special use?
   a. Farmers' Bulletin No. 856, p. 10.
7. What is the value of Soap Preparations?
   a. Farmers' Bulletin No. 856, p. 11.

8. For what is Sulphur used?
   a. Farmers' Bulletin No. 856, p. 12.
9. What are some of the mechanical methods of insect control?
   a. Farmers' Bulletin No. 856, p. 12.
10. What are the two general classes of injurious garden insects?
   a. Farmers' Bulletin No. 856, p. 14.
11. How control the Cutworm?
   a. Farmers' Bulletin No. 856, p. 15.
12. What is the White Grub and its control?
   a. Farmers' Bulletin No. 856, p. 16.
13. What are Aphis or "Plant Lice" and control?
   a. Farmers' Bulletin No. 856, p. 18, 19.
14. How control the Onion Thrips?
   a. Farmers' Bulletin No. 856, p. 19.
15. What suggestions for control of the Red Spider?
   a. Farmers' Bulletin No. 856, p. 21.
16. How dispose of Slugs and Snails?
   a. Farmers' Bulletin No. 856, p. 21, 22.
17. What us Damping-off and prevention?
   a. Farmers' Bulletin No. 856, p. 23.
18. What are Bean Anthracnose and Blight and method of control?
   a. Farmers' Bulletin No. 856, p. 25, 26.
19. How is the Common Cabbage Worm controlled?
   a. Farmers' Bulletin No. 856, p. 31, 32.
20. How control Cabbage Aphis?
   a. Farmers' Bulletin No. 856, p. 35.
21. How control the Cabbage Maggot?
   a. Farmers' Bulletin No. 856, p. 36.
22. How control the Corn Ear Worm?
   a. Farmers' Bulletin No. 856, p. 42.
23. How control the Cucumber Beetle?
   a. Farmers' Bulletin No. 856, p. 43, 44, 45.
24. What method of control for the Melon Aphis?
   a. Farmers' Bulletin No. 856, p. 45, 46.
25. What is the control of the "Onion Maggot"?
   a. Farmers' Bulletin No. 856, p. 51.
26. What is the control of the Potato Beetle?
   a. Farmers' Bulletin No. 856, p. 55, 56.
27. How treat Potato Scab?
   a. Farmers' Bulletin No. 856, p. 58.
28. How control the Squash Bug?
   a. Farmers' Bulletin No. 856, p. 61.
29. How control the Squash Vine Borer?
   a. Farmers' Bulletin No. 856, p. 61, 62.
30. How control the Tomato Worms?
   a. Farmers' Bulletin No. 856, p. 67, 68.
31. How control Gophers and Ground Squirrels?
   a. Consult some local gardener.
   b. Consult the County Horticultural Commissioner.
   c. Bulletin No. 281. Control of the Pocket Gopher in California, College of Agriculture, University of California.

XVI - Utilization of Garden Products.
1. What are available for immediate consumption in the home?
2. What will you market?
3. What will be stored for future use?
4. What will you can?

VEGETABLE GROWING PROJECTS.

I - Introductory Discussion of Vegetables.
1. Possible classifications.
a. By food parts under such headings as "Roots we eat", "Leaves we eat", "Seeds and seed pods we eat", "Stalks we eat", "Plants we grow for garnishes".
b. According to date of planting or earliness of maturity in the open as "first early", "second early", "third early", "fourth early", or "late".
c. Vegetables also classified according to certain botanical characteristics. Under this classification "early" and "late" vegetables may be found in the same group; also, vegetables in a given group, as for example those of the parsnip family (Umbelliferae), may differ radically as to their food parts, and run from roots we eat to edible leaves and seeds. The parsnip family includes even the most important garnish plant. Our garden herbs and vegetables belong to at least 17 plant families.
2. Classification by Methods of Cultivation. (Bailey in "Principles of Vegetable Gardening".)
Class I - Annual Vegetables.
Sub-Class 1 - Crops Grown for Subterranean Parts.
Group 1 - Root Crops.
Beet, Beta vulgaris.
Carrot, Daucus Carota.
Parsnip, Pastinaca sativa.
Radish, Raphanus sativus.
Salsify, Tragopogon porrifolius.
Turnip and Rutabaga, Brassica.
Group 2 - Tuber crops.
Potato, Solanum tuberosum.
Group 3 - Bulb Crops.
Onion, Allium Cepa, A. fistulosum.
Leek, Allium Porrum.
Sub-Class 2 - Crops Grown for Foliage Parts.
Group 4 - Cole Crops.
Cabbage, Brassica oleracea.
Cauliflower, Brassica oleracea.
Kohlrabi, Brassica oleracea.
Group 5 - Pot-herb Crops (used for "Greens").
Spinach, Spinacea deracea.
Beet, Beta vulgaris.
Dandelion, Taraxacum officinale (This is a perennial, but when grown in a garden is an annual.)

Group 6 - Salad crops.
Lettuce, Lactuca sativa.
Endive, Cichorium Endivia.
Celery, Aprium graveolens.
Parsley, Carum Petroselinum.
Sub-Class 3 - Crops Grown for Fruit or Seed Parts.
Group 7 - Pulse crops.
Bean, Phaseolus, Dolichos, Vicia.
Pea, Pisum sativum.
Group 8.- Solanaceous crops.
Tomato, Lycopersicum esculentum.
Eggplant, Solanum Melongena.
Pepper, Capsicum annuum.
Group 9 - Cucubitous or Vine Crops.
Cucumber, Cucumis sativus.
Melon, C. Melo.
Squash, Cucurbita.
Group 10 - Corn.
Sweet Corn, Zea Mays.
Class II - Perennial Vegetables.
Asparagus, Asparagus officinalis.
Rhubarb, Rheum Rhaponticum.

3. Aid to Garden Planning.

a. Familiarity with the general cultural requirements of the various groups is necessary to the first intelligent steps in home-garden planning. These requirements are given by various authorities. The following notes are from Bailey's "Principles of Vegetable Gardening".

Group 1. Root crops require a cool season and deep soil. They are grown in drills, and are usually not transplanted. They are used both as main-season and secondary crops. All are hardy. No special skill is required in growing them.

The necessity of deep soil is apparent when one considers that the value of a root depends to a large extent on its straightness or symmetry. In hard and shallow soils roots are short and they tend to be branched and irregular. Fine tilth does much to insure quick growth, and quick growth improves the quality.

Group 2. Tuber crops. The potato. Deeply pulverized, cool soil, holding much capillary moisture and rich in potash, deep and early planting, level culture, frequent surface tillage to conserve moisture, spraying to insure healthy foliage---these are the requisites of the best potato culture. The potato is propagated by means of tubers. It thrives best in a relatively cool climate; in the south it is successful only as a spring and fall crop, for the midsummer is too continuously hot. In most cases a heavy yield of potatoes is largely a question of moisture.

Group 3. Bulb Crops. All the bulb crops are hardy, require a cool season, and moist, rich soil, with a loose surface. Usually they are not seed-bed crops. They are used both as a main-seaon and secondary crop. They are propagated by both seeds and bulbs. These crops are grown chiefly for the underground bulbs (but the leaves are often used in stews and seasonings).

Group 4. Cole Crops. All cole crops are hardy and demand a cool season and soil and abundance of moisture at the root. Except the kales and kohlrabi, all are seed-bed crops, and even kales are often started in beds. Each plant requires considerable space in order to develop well. Cole crops are grown for the vegetative aerial parts rather than for fruits or roots.

Group 5. Pot-herb Crops. Pot-herb crops, or "greens", are grown for their leaves; therefore they must make quick growth in order to be crisp and tender; the ground must have good surface tilth and much available plant food; the application of soluble nitrogenous substances is usually important, particularly when the growth is nearing completion. Most pot-herbs demand a cool season, and nearly all of them are partial-season crops, and therefore treated as succession or companion crops.

Group 6. Salad Crops. As a general statement, it may be said that salad plants require cool, moist soil, and a quick, continuous growth, if the best results are attained. They are often benefitted by a special application of quickly available fertilizers during growth, particularly of nitrogen in those species which are desired chiefly for a quick growth of leaves.

Group 7. Pulse crops. Botanically, peas and beans are very closely related, but they have few points in common from the cultural point of view, since peas are hardy, cool-season plants and beans are tender, warm-season plants. Both are leguminous crops and therefore capable of using atmospheric nitrogen. As garden crops, however, they may need applications of nitrogen in order to secure a quick start, particularly if an early crop is desired. "It is frequently the wiser economy to apply nitrogen, particularly if they are raised upon land which has not been previously palnted with these crops and thus may not possess the specific nitrogen-gathering bacteria". (Voorhees' "Fertilizers", p. 269.)

Peas: Peas are a partial-season crop, requiring cool season and a soil not over-rich; seed is sown where the plants are to stand; grown in drills, hardy.

Beans: Garden beans represent several species, but all the common kinds are very tender to frost and require a warm season and sunny exposure; seed is sown where the plants are to grow; usually grown in drills, except the tall kinds; the common bush beans are partial-season plants.

Group 8. Solanaceous crops. Tomatoes, eggplants and their kin and hot-season plants. They require nearly or quite the entire season in which to mature. Usually they grow until killed by frost, at least in the north, and the production of a heavy crop depends on getting an early start. They are seed-bed crops, and they need abundance of quick-acting fertilizers applied relatively early in their growth. They are grown in hills.

Group 9. Cucurbitous or vine crops. Cucurbitous crops are annuals, grown for their fruits; they are tender to frost; they require a warm season and a full exposure to the sun; they are long-season crops, and with most of them a quick start is essential in order that they may mature the crop before fall; they are grown in hills, as a main crop; they are planted in the field or in frames, depending on the region and the period at which the crop is wanted; they transplant with difficulty, and if the plants are started in advance of the season they are grown in pots, boxes or on sods.

Group 10. Corn (other names omitted). The plants here mentioned are all warm-weather crops; they are annuals, or grown as such, and they are cultivated for their immature fruits; they should have quick soil; usually they are not transplanted; other than good tillage, no special treatment is required.

Group 11. Perennial Crops. The management of perennial crops differs from that of other vegetable-gardening crops in the fact that they are more or less permanent occupants of the ground and therefore must be given an area to themselves, where they will not interfere with the customary plowing and tilling; in the fact that the chief tillage and care are required early and late in the season; and also because the fertilizing is secured chiefly by surface dressings in spring and fall.

II - The Bean Project.

A - Beans may be grown either for "green" food or for "dry" food. The following suggested outlines have for their object the growing of one or more of the fifteen varieties of "dry" beans that are of commercial importance and are staples on the California markets. Any reliable seed catalogue lists varieties of "green" beans such as "Golden wax", "Kentucky Wonder", "Lazy Wife", etc. A few rows or a plat of a quarter acre or so may be grown of a good variety of "green" beans for immediate consumption in the home or for canning. In the main the following outlines will apply to a "green" bean project as well as to a "dry" bean project. See Wickson - Pages 166, 167, 168, 169, 170 for garden culture of beans.

B - References:

1. Bulletin No. 294, Bean Culture in California, by G. E. Hendry, College of Agriculture, University of California. A most valuable publication - Issued April, 1918.
2. Wickson, The California Vegetables in Garden and Field.
3. Bailey, The Principles of Vegetable Gardening.

(The last two references are valuable for all phases of vegetable growing and garden work in general).

C. Outline Questions:

1. What varieties of beans are of commercial importance in California? Bulletin 294, p. 289.
2. Which of these varieties grow best in your immediate locality? Bulletin 294, p. 319. Also consult some successful local grower.
3. Which of these varieties will you try to grow?
4. What are the things for you to determine with reference to the seed you will need? Bulletin 294, p. 331.
5. What kind of soil is best for beans?
   a. Bulletin 294, p. 322, 323.
   b. Wickson, p. 157.
   c. Bailey, p. 385.
6. What is the condition of your soil?
7. How can you improve it?
8. How large a plot of beans will you grow?
9. How prepare land for beans?
   a. Bulletin 294, p. 297, 324, 325, 326.
   b. Wickson, p. 157.
10. What change or adaptation in above to prepare the seed-bed for your particular plot?
11. When is the best time to plant your beans?
   a. Bulletin 294, p. 326, 327, 328.
   b. Wickson, p. 159.
12. What is the best way of planting?
   a. Bulletin 294, p. 329, 330, 331.
   b. Wickson, p. 159.
   c. Bailey, p. 387.
13. How secure a uniform stand of plants? Bulletin 294, p. 331.
14. How cultivate your beans?
   a. Bulletin 294, p. 331.
   b. Wickson, p. 160.
15. How will you modify above in cultivating your particular plot?
16. What tools will you use?
17. Will you employ hand labor only?
18. During the preparation of your soil and the growing and harvesting of your crop, what items will you record as to cost of growing the crop?
19. How irrigate your beans if necessary to irrigate? Bulletin 294, p. 332
20. When, why and how will you cultivate after irrigation?
21. Can you raise beans on your plot without irrigation?
22. How control insect and other enemies of your beans?
   a. Bulletin 294, p. 344, 345, 346, 347.
   b. Wickson, p. 314, 315, 316, 317, 318, 319, 320.
23. When is the best time to harvest your beans?
   a. Bulletin 294, p. 332, 333.
   b. Wickson, p. 160.
24. What is the best method of harvesting?
   a. Bulletin 294, p. 333.
   b. Wickson, p. 160.
25. How follow above directions for your own particular plot?
26. How are beans threshed?
   a. Bulletin 294, p. 334, 335.
   b. Wickson, p. 161, 162, 163.

27. How will you thresh your crop?
28. How are beans prepared for market?
    a. Bulletin 294, p. 335, 336.
    b. Wickson, p. 163.
29. How will you prepare your beans for market?
30. When will you market them?
31. What is the cost of growing beans? Bulletin 294, p. 338, 339.
32. What is the total cost of growing your plot of beans?
33. What food qualities do beans possess? Bulletin 294, p. 341, 342, 343.
34. What is the agricultural history of the particular variety of bean you grew? See Bulletin 294 under each variety.
35. What things of educational value have you learned in your study and growing of beans?
36. Did you take any pictures of your bean crop?
37. What items and illustrations will enter into your final report or booklet on "How I Grew My Beans"?

II - The Beet (table) Project.

A - The beet growing project may be that of the common table beet grown in the garden or the sugar beet grown under field conditions. The cultural requirements are pretty much the same. The beet has been cultivated for more than 2,000 years. Under cultivation the wild beet, Beta vulgaris, has given rise to three types of root beets, viz: garden beets, sugar beets and mangel-wurzels or stock beets. Of foliage beets there are two types, viz: chard, used for greens; ornamental beets used in flower gardens and lawns.

B - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.
3. Correspondence Course in Vegetable Gardening by S. S. Rogers, College of Agriculture, University of California.

C - Outline Questions.

1. What is the early history of the beet?
    a. Bailey, p. 280.
    b. Correspondence Course, Lesson 11, p. 2.
2. To what cultural class of plants does the beet belong?
    a. Bailey, p. 240.
3. When may beets be grown in California?
    a. Wickson, p. 171.
4. Where may it be grown in California?
    a. Correspondence Course, Lesson 11, p. 2.
5. What are the two general types of vegetable-garden beets?
    a. Bailey, p. 277.
6. What varieties are grown in California?
    a. Wickson, p. 173.
    b. Correspondence Course, Lesson 11, p. 4.
7. Which variety will you grow?

8. How many rows will you grow?
9. Will you sow them all at one time?
   a. Bailey, p. 279.
10. How much seed will you need?
   a. Bailey, p. 280.
11. Where will you get your seed?
12. What is peculiar about the seed of the beet?
   a. Bailey, p. 278.
13. Why do beet seed require plenty of moisture to germinate?
14. Will you test your seed before planting?
15. What kind of soil is best for beets?
   a. Bailey, p. 277.
   b. Wickson, p. 172.
   c. Correspondence Course, Lesson 11, p. 2, 3.
16. What kind of soil in your garden?
17. How best prepare it for the growing of beets?
18. What climatic and moisture conditions for the best growth of the beet?
   a. Wickson, p. 172.
   b. Bailey, p. 277.
19. When may you sow beet seed in California?
   a. Correspondence Course, Lesson 11, p. 3.
   b. Wickson, p. 172 (bottom).
20. How sow seed in the garden?
   a. Wickson, p. 172.
   b. Bailey, p. 280.
21. When should the beets be thinned?
   a. Wickson, p. 173.
22. When are beets used for greens?
   a. Bailey, p. 279.
23. What cultivation of the growing crop is necessary?
   a. Wickson, p. 172.
   b. Correspondence Course, Lesson 11, p. 3.
24. Will your cultivation be deep or shallow? Why?
25. How often will you irrigate?
   a. Wickson, p. 172.
   b. Correspondence Course, Lesson 11, p. 3.
26. Why will you cultivate after irrigation?
27. When will you harvest your beets?
28. How are beets marketed?
   a. Correspondence Course, Lesson 11, p. 4.
   b. Bailey, p. 279.
29. What does it cost to grow beets?
   a. Correspondence Course, Lesson 11, p. 2.
30. What did it cost you to grow your beets?
31. What did you receive for your beets?
32. Why is it not worth while to store beets?
33. Will you make a final written report?

IV - The Beet (sugar) Project.

A - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.

3. Circular No. 165, Fundamentals of Sugar Beet Culture Under California Conditions, by R. L. Adams, College of Agriculture, University of California.
4. Farmers' Bulletin No. 52, The Sugar Beet, U. S. Dept. of Agriculture.
5. Farmers' Bulletin No. 392, Irrigation of Sugar Beets, U. S. Dept. of Agriculture.
6. Farmers' Bulletin No. 567, Sugar-Beet Growing Under Irrigation, U. S. Dept. of Agriculture.
7. Farmers' Bulletin No. 772, The Control of the Sugar-Beet Nematode, U. S. Dept. of Agriculture.

B - Questions Outlines:

1. What is the history of the beet?
   a. Bailey, p. 280.
2. What conditions are favorable to the growing of the sugar beet in California?
   a. Wickson, p. 174.
   b. Circular 165, p. 2.
3. Where are the sugar-beet factories located?
   a. Circular 165, p. 1.
4. What conditions are necessary for the commercial growing of sugar beets?
   a. Circular 165, p. 1.
   b. Bulletin 52, p. 3.
5. What is the beet-sugar belt of the United States?
   a. Bulletin 52, p. 4, 5, (Map).
6. What are the varieties of sugar beets grown?
   a. Bulletin 52, p. 8, 9, 10.
   b. Wickson, p. 179.
7. What variety will you grow and where will you get the seed?
   a. Write to the manager of your nearest sugar beet factory.
8. How are beet seed grown?
   a. Bulletin 52, p. 27, 28.
9. How does home grown seed compare with foreign grown?
   a. Bulletin 52, p. 29.
10. What is "single-germ" beet seed and why desirable?
    a. Bulletin 52, p. 30.
11. How much seed is needed to plant an acre?
    a. Bulletin 52, p. 30.
12. How much will you need to plant your plot?
13. Will you test your seed? Why?
14. What is meant by growing sugar beets " under contract"?
    a. Circular 165, p. 2, 3, 4.
15. What important factors must be considered in the contract?
    a. Circular 165, p. 4.
16. How do you expect to market the sugar beets from your plot?
17. How large a plot will you grow?
18. What soils are best for sugar beets?
    a. Circular 165, p. 2.
    b. Wickson, p. 174, 175.
    c. Bulletin 52, p. 11.

19. What kind of soil in your sugar beet plot?
20. How will you fertilize your soil, if necessary?
    a. Bulletin 52, p. 11.
    b. Bulletin 567, p. 21, 22.
21. What are the successive steps in the preparation of the seed-bed
    a. Circular 165, p. 6, 7.
    b. Wickson, p. 175.
    c. Bulletin 567, p. 6, 7, 8.
22. How will you prepare the seedbed in your plot?
23. When is the time to plant sugar-beet seed?
    a. Circular 165, p. 7, 8.
24. How will you plant the seed?
    a. Wickson, p. 176.
    b. Circular 165, p. 9.
25. When and how often cultivate?
    a. Wickson, p. 176, 177.
    b. Circular 165, p. 10.
    c. Bulletin 52, p. 17, 18, 19.
26. When thin the beets?
    a. Wickson, p. 177.
    b. Circular 165, p. 11.
27. In thinning, what selection of plants should you make?
    a. Circular 165, p. 11.
    b. Wickson, p. 177.
    c. Bulletin 567, p. 15, 16, 17.
28. How should your beets be irrigated?
    a. Bulletin 567, p. 10, 11, 12.
    b. Circular 165, p. 11, 12.
29. Why cultivate after irrigation and when?
    a. Bulletin 567, p. 12, 13.
30. What are some of the reasons for crop failure under irrigation?
    a. Bulletin 392, p. 40.
31. When is the time to harvest the beets?
    a. Circular 165, p. 13.
    b. Wickson, p. 177.
    c. Bulletin 567, p. 19.
32. How are sugar beets harvested?
    a. Circular 165, p. 14.
    b. Bulletin 567, p. 19, 20.
33. Why should there be crop rotation in sugar beet growing?
    a. Bulletin 567, p. 20, 21.
    b. Circular 165, p. 15, 16.
34. What is the Curly Top Disease and how controlled?
    a. Circular 165, p. 17, 18.
35. What is the life-history of the sugar-beet nematode?
    a. Bulletin 772, p. 3, 4, 5.
36. What is the best field method of checking the nematode?
    a. Bulletin 772, p. 16, 17.
37. What does it cost to grow sugar beets?
    a. Circular 165, p. 20, 21.
38. What was the cost of growing your plot?
39. What items will you include in your final report?

V - The Cabbage Project.

A - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.
3. Correspondence Course in Vegetable Gardening, by S. S. Rogers, College of Agriculture, University of California.
4. Circular No. 130, Cabbage Growing in California, by S. S. Rogers, College of Agriculture, University of California.
5. Farmers' Bulletin No. 433, Cabbage, U. S. Dept. of Agriculture.
6. Farmers' Bulletin No. 925, Cabbage Diseases, U. S. Dept. of Agriculture.

B - Outline Questions:

1. What is the early history of the cabbage plant?
   a. Circular 130, p. 2.
2. What distinct types of cultivated cabbage have been derived from the wild cabbage?
   a. Circular 130, p. 2.
3. What varieties are most commonly grown in California?
   a. Circular 130, p. 3.
   b. Wickson, p. 187, 188.
4. What is the importance of the cabbage crop in California?
   a. Correspondence Course, Lesson 9, p. 2.
   b. Wickson, p. 182.
5. What are the different members of the cabbage family?
   a. Bailey, p. 329.
6. Why are they called the "cole" crops?
7. What variety of cabbage will you grow?
8. Where will you get your seed?
9. How much seed will you need?
   a. Correspondence Course, Lesson 9, p. 3.
10. How large a cabbage plot will you grow?
11. What should be the character of the seed?
    a. Farmers' Bulletin 433, p. 8.
12. Will you grow your plants in a seed-bed or flat?
    a. Circular 130, p. 6.
    b. Correspondence Course, Lesson 9, p. 3.
    c. Wickson, p. 184.
13. Will you grow your plants in the open?
    a. Circular 130, p. 7.
    b. Correspondence Course, Lesson 9, p. 3.
14. How will you move your plants from the seedbed for the final planting in your plot?
    a. Circular 130, p. 7.
15. What kind of soil is suitable for cabbage?
    a. Wickson, p. 183.
    b. Circular 130, p. 5.
    c. Farmers' Bulletin 433, p. 14, 15.
16. What kind of soil in your plot?
17. How is soil prepared for cabbage growing?
    a. Wickson, p. 185.
    b. Circular 130, p. 10.
    c. Farmers' Bulletin 433, p. 7.

18. What things are you planning to do to get your soil ready to grow the plants?
19. When will you begin your work?
20. What is the most practical fertilizer for you to use?
21. How much will you need?
22. What will it cost you?
23. When will you apply it?
24. When will you transplant your plants?
25. How far apart are cabbage plants set?
    a. Wickson, p. 185, 186.
    b. Circular 130, p. 11.
    c. Farmers' Bulletin 433, p. 16.
    d. Bailey, p. 333, 334.
26. How far apart will you set the plants in your plot?
27. What special care must you observe in setting out your plants?
    a. Correspondence Course, Lesson 9, p. 4.
28. What cultivation is best for the growing cabbage?
    a. Wickson, p. 187.
    b. Circular 130, p. 12.
29. How will you cultivate your plot?
30. What tools will you use?
31. How often is it necessary to cultivate?
    a. Bailey, p. 334.
    b. Farmers' Bulletin 433, p. 16.
32. Are you willing to make that effort for success?
33. How will you irrigate your crop?
    a. Circular 130, p. 12, 13.
    b. Correspondence Course, Lesson 9, p. 4, 5.
34. Will you watch your plants for injurious insects?
35. How control the cabbage worm?
    a. Circular 130, p. 20 (important).
    b. Farmers' Bulletin 433, p. 10.
36. Do you know the cabbage butterfly when you see it?
37. How can you tell the female from the male butterfly?
38. Do you know what the cabbage aphis is?
39. How control the cabbage aphis?
    a. Circular 130, p. 20, 21.
    b. Farmers' Bulletin 433, p. 10.
40 What is the clubroot disease in cabbage and how controlled?
    a. Farmers' Bulletin 433, p. 10, 11.
    b. Farmers' Bulletin 925, p. 9, 10.
41. When will you harvest your cabbage?
    a. Circular 130, p. 13.
    b. Correspondence Course, Lesson 9, p. 5.
    c. Farmers' Bulletin 433, p. 16.
42. What market do you have for your crop?
43. How is cabbage stored?
    a. Circular 130, p. 13, 14.
    b. Farmers' Bulletin 433, p. 17(illustration) p.20,21,22, 23.
44. What does it cost to grow cabbage?

a. Circular 130, p. 16.
b. Bailey, p. 338.

45. What did it cost you to grow your crop?
46. What items will you include in your final report?

VI - The Cauliflower Project.

A - The treatment of all cole crops may be compared to that of cabbage. Corbett in "Garden Farming" says:- "Cauliflowers is known to the botanical world as a variety of cabbage, Brassica oleracea, var. botrytis D. C. Although a derivative of the cabbage, it differs from it in conformation and structure. The edible portion, called the curd, or head, is composed of the thickened flower stems, which have changed in size and appearance under cultivation into a homogenous, curdlike mass. In good strains of cauliflower the curd is very compact and free from leaves or elongated segments".

B - References:

1. Wickson, The California Vegetables in Garden and Field.
2. Correspondence Course in Vegetable Gardening, by S. S. Rogers, College of Agriculture, University of California.
3. Bailey, The Principles of Vegetable Gardening.

C - Outline Questions:

1. Have you ever seen cauliflower growing?
2. What is the early history of the cauliflower?
   a. Correspondence Course, Lesson 9, p. 7.
3. How does the culture of cauliflower differ from that of cabbage?
   a. Bailey, p. 341.
   b. Wickson, p. 189.
4. What situations are best for cauliflower?
   a. Wickson, p. 189.
5. Is your garden suitable for the growth of cauliflower?
6. If not, can you make it so?
7. What varieties are grown in California?
   a. Correspondence Course, Lesson 9, p. 8.
   b. Wickson, p. 192.
   c. Any reliable seed-catalogue.
8. What variety will you grow?
   a. Consult some successful local grower.
9. Where will you get your seed?
10. How much seed will you need?
11. How large a plot of cauliflower will you grow?
12. How will you grow your plants?
   a. Wickson, p. 190.
13. What are the soil requirements for cauliflower?
   a. Wickson, p. 189.
14. How will you prepare your soil for cauliflower?
15. When will you set out your plants?
   a. Wickson, p. 190.
16. How will you cultivate cauliflower?
   a. Same as cabbage.

17. How will you irrigate?
    a. Same as cabbage.
18. How much moisture does cauliflower need?
    a. Wickson, p. 191.
19. What diseases and insect pests afflict cauliflower?
    a. Same as cabbage.
20. What treatment of the cauliflower is necessary when it begins to head?
    a. Wickson, p. 191.
    b. Correspondence Course, Lesson 9, p. 7, 8.
21. In what condition should your cauliflower be to sell well?
22. What have you learned in growing your cauliflower?
23. Did you make any money?
24. Did you receive any pleasure in growing the crop?

VII - The Carrot Project.

The carrot belongs, botanically, to the great family Umbelliferae, to which also belong celery, caraway and parsnip. It is grown both as a field and garden crop. Garden culture only is considered here.

A - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.
3. Any good seed catalogue.

B - Outline Questions:

1. How long has the carrot been cultivated?
    a. Bailey, p. 283.
2. To what cultural class of plants does it belong?
    a. Bailey, p. 240.
3. Have you ever seen carrots growing?
4. What is the color of the foliage?
5. What is the color of the root?
6. How many rows of carrots will you grow?
7. How much seed will you need?
    a. Bailey, p. 283.
    b. Any good seed catalogue.
8. Where will you get your seed?
9. What must be the condition of your seed?
10. What varieties are grown in California?
    a. Wickson, p. 198.
11. When may carrot seed be sown?
    a. Wickson, p. 196.
    b. Bailey, p. 281.
12. How many rows of carrots will you grow?
13. When did it last grow carrots?
14. Why is rotation of crops advisable?
15. What kind of soil is best for carrots?
    a. Wickson, p. 195.
    b. Bailey, p. 281.
16. What kind of soil have you?
17. Will you grow a winter or a summer crop?

18. In what condition must the soil be before sowing the seed?
    a. Wickson, p. 196.
    b. Bailey, p. 281.
19. How will you prepare your soil for carrots?
20. How long does it take carrots to mature?
    a. Bailey, p. 282.
    b. Any good seed catalogue.
21. What variety will you grow?
22. How are the seed sown in the ground?
    a. Bailey, p. 282.
23. How will you cultivate?
24. How will you irrigate?
25. Will you try to grow carrot seed?
26. Is the carrot an annual or a biennial?
    a. Bailey, p. 283.
27. When will you harvest your carrots?
28. How did you market them?
29. Will you make a final written report?

VIII - The Corn (Sweet) Project.

The cultivation and growing of sweet corn does not differ from that of ordinary field corn. It is not limited by climatic conditions for in growing sweet corn (except by seedsmen) only immature ears are desired for immediate use on the table or for canning.

A - References:

1. Correspondence Course in Corn Culture, by B. A. Madson, College of Agriculture, University of California.
2. Wickson, California Vegetables in Garden and Field.
3. Bailey, The Principles of Vegetable Gardening.
4. Farmers' Bulletin No. 414, Corn Cultivation, U. S. Dept. of Agriculture.
5. Farmers' Bulletin No.773, Corn Growing Under Droughty Conditions, U. S. Dept. of Agriculture.
6. Farmers' Bulletin No. 298, Food Value of Corn and Corn Products, U. S. Dept. of Agriculture.

B - Outline Questions.

1. To what class of plants does sweet corn belong?
    a. Bailey, p. 423.
    b. Correspondence Course, Lesson 1, p. 2.
2. What are the main types of corn in general?
    a. Correspondence Course, Lesson 3, p. 2.
3. What are the principal characteristics of each type?
    a. Correspondence Course, Lesson 3, p. 2, 3, 4, 5, 6, 7.
4. How many of these six types have you seen?
5. How have the many varieties of corn been developed?
    a. Correspondence Course, Lesson 3, p. 8.
6. What are the varieties of field corn suitable for California?
    a. Correspondence Course, Lesson 3, p. 8, 9, 10.
7. What are the varieties of sweet corn suitable for California?
    a. Correspondence Course, Lesson 3, p. 11, 12.
    b. Wickson, p. 216.

14. In what connection must you don't be before [illegible]
15. [illegible]
16. [illegible]
17. How will you prepare [illegible]
18. Can [illegible]
19. [illegible]
20. [illegible]
21. What variety will you grow?
22. How are the seed sown in the ground?
23. [illegible]
24. [illegible]
25. [illegible]
26. In the region [illegible]
27. When will you [illegible]
28. How did you [illegible]
29. Will you [illegible]

II - The Corn (Maize) Project:

The cultivation and growing of every sort is done [illegible] that of ordinary field corn. It is not [illegible] for in practice sweet corn (except by [illegible] varieties were [illegible] desired [illegible] use on the table [illegible].

A - Literature:

1. [illegible] Dame [illegible], 19[illegible]. [illegible] of Corn[illegible]
2. [illegible], California Vertebrate [illegible].
3. [illegible], The Principles of [illegible] Breeding.
4. [illegible], Bulletin No. 114, Corn [illegible]. U. S. Dept. of Agriculture.
5. [illegible], Bulletin No. 279, Corn for [illegible] Growing Conditions, U. S. Dept. of Agriculture.
6. [illegible], Bulletin No. [illegible], Feed Value of Corn and Corn Products, U. S. Dept. of Agriculture.

B - Questions [illegible]:

1. [illegible]
2. What [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]
7. [illegible]

8. What variety do you think is best for your locality?
   a. Consult the best local grower.
9. Where will you get your seed?
10. What is the importance of good seed?
   a. Correspondence Course, Lesson 5, p. 4.
11. Why test your seed before planting?
   a. Correspondence Course, Lesson 5, p. 8.
12. When should you test your seed?
   a. Correspondence Course, Lesson 5, p. 8.
13. What is the best way for you to test your seed?
   a. Correspondence Course, Lesson 5, p. 9, 10.
14. How large a plot of sweet corn will you grow?
15. Why should the shape of your plot be such that you can grow a number of short rows rather than one or two very long rows?
16. Will the way in which the corn plant is pollinated help you to answer the above question?
17. What are the flowers on a corn plant?
   a. Correspondence Course, Lesson 1, p. 7, 8.
18. What soil conditions are best for corn?
   a. Correspondence Course, Lesson 2, p. 6, 7, 8.
   b. Wickson, p. 213.
   c. Bailey, p. 424.
19. What are the purposes of cultivation under semi-arid conditions?
   a. Correspondence Course, Lesson 4, p. 2.
   b. Bulletin 773, p. 9.
20. How prepare the soil for corn growing?
   a. Correspondence Course, Lesson 4, p. 3, 4, 5, 6.
   b. Bulletin 773, p. 10, 11, 12.
21. What is meant by "organic matter" in the preparation of the soil for corn?
   a. Correspondence Course, Lesson 4, p. 9, 10.
22. How prepare the seed-bed for corn?
   a. Correspondence Course, Lesson 5, p. 2, 3, 4.
   b. Wickson, p. 213.
23. What things will you do to make the seed-bed of your plot as good as possible?
24. When will you plant your corn?
   a. Correspondence Course, Lesson 6, p. 8, 9.
   b. Wickson, p. 213.
   c. Bailey, p. 425.
   d. Bulletin 773, p. 12, 13.
25. Will you plant your corn in hills or drill it?
   a. Correspondence Course, Lesson 6, p. 3, 4, 5.
   b. Wickson, p. 214.
26. How deep will you plant your corn?
   a. Correspondence Course, Lesson 6, p. 7, 8.
   b. Wickson, p. 214, 125, 126, 127.
27. What are the objects of cultivation?
   a. Correspondence Course, Lesson 7, p. 2, 3.
   b. Wickson, p. 216.
   c. Bulletin 773, p. 16, 17, 18.
   d. Bulletin 414, p. 11.

28. What tools will you use to cultivate your plot?
29. How often will you cultivate?
30. How deep will you cultivate?
    a. Correspondence Course, Lesson 7, p. 4.
    b. Bulletin 773, p. 17.
    c. Bailey, p. 426.
31. How will you irrigate your corn, if necessary?
    a. Correspondence Course, Lesson 7, p. 9, 10.
32. When is the best time to irrigate?
    a. Correspondence Course, Lesson 7, p. 10, 11.
    b. Bulletin 773, p. 19.
33. What mistakes are made in irrigation?
    a. Bulletin 773, p. 19.
    b. Correspondence Course, Lesson 7, p. 11, 12.
34. Why cultivate after irrigation?
35. How soon cultivate after irrigation?
36. What kinds of roots has the corn plant?
    a. Correspondence Course, Lesson 1, p. 3, 4, 5.
37. How are the leaves arranged on the corn plant?
    a. Correspondence Course, Lesson 1, p. 7.
38. What are nodes and inter-nodes and how does a corn stalk increase in length?
    a. Correspondence Course, Lesson 1, p. 5, 6.
39. What is the ear of the corn plant?
    a. Correspondence Course, Lesson 1, p. 9, 10.
40. What enemies must you fight in growing your sweet corn?
    a. Correspondence Course, Lesson 8, p. 2.
    b. Bulletin 733.
41. Which is the easiest for you to conquer?
42. What is the price of victory?
43. What is the life history of the corn-ear worm?
    a. Correspondence Course, Lesson 8, p. 7.
44. How control it?
    a. Correspondence Course, Lesson 8, p. 8.
45. How are grasshoppers and armyworms controlled?
    a. Correspondence Course, Lesson 8, p. 9.
46. What animal pests destroy corn?
    a. Correspondence Course, Lesson 8, p. 12, 13.
47. When will you harvest your corn?
48. What market will you have?
49. Will you select seed for next year?
50. What are the best methods of selecting seed corn?
    a. Correspondence Course, Lesson 5, p. 5, 6, 7.
51. What is the food value of corn?
    a. Bulletin 298, p. 26, 27, 29, 30, 31, 34, 35, 36.
52. What did you gain in money by growing your sweet corn?
53. What did you gain in knowledge?

IX - The Lettuce Project.

A - Botanically lettuce is known as Lactuca sativa. The "wild lettuce" is known as Lactuca scariola. Corbett gives four types of the cultivated lettuce, viz:- Head (or cabbage) lettuce, Lactuca capitata; cutting (or cut-leaved) lettuce, Lactuca intybacea; Cos lettuce (or romaine) Lactuca Romana; asparagus lettuce, Lactuca augustana (little known in this country).

B - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.
3. Circular No. 160, Lettuce Growing in California, by S. S. Rogers, College of Agriculture, University of California.
4. Correspondence Course in Vegetable Gardening, by S. S. Rogers, College of Agriculture, University of California.

C - Outline Questions.

1. What are the salad crops?
   a. Bailey, p. 356.
2. What are the best climatic and soil conditions for salad crops?
   a. Bailey, p. 356.
3. Why is extra care necessary in the growing of salad plants?
   a. Bailey, p. 356, 357.
4. What is a salad when ready for the table?
5. How does lettuce rank in importance among the salad plants?
6. What is the importance of lettuce growing in California?
   a. Wickson, p. 224.
   b. Correspondence Course, Lesson 10, p. 8, 9.
   c. Circular 160, p. 2.
7. Where may it be grown in the state?
8. What are the principal lettuce growing districts?
   a. Circular 160, p. 2.
9. What varieties of lettuce are grown in California?
   a. Circular 160, p. 14.
   b. Wickson, p. 228.
10. What are the four leading varieties in the State?
    a. Circular 160, p. 14, 15.
11. What variety will you grow?
12. How large a plot will you grow?
13. How many rows will there be in the plot?
14. How much seed will you need?
15. Where will you get your seed?
16. In what two ways may lettuce seed be sown?
    a. Correspondence Course, Lesson 10, p. 10.
    b. Bailey, p. 357.
    c. Circular 160, p. 7.
17. What is the simplest method for the farm garden?
    a. Wickson, p. 225.
18. When will you sow your seed?
19. Will you sow them in a bed or flat and then transplant?
20. How is a seedbed made for growing plants on a large scale?
    a. Circular 160, p. 7, 8.

21. What is necessary for you to grow the plants you will need?
22. When may plants be transplanted?
    a. Circular 160, p. 8.
23. Will you sow the seed directly in the ground where the crop is to grow?
24. If so, when and how will you thin out?
25. How far apart should lettuce plants stand in the row?
26. How far apart should the rows be?
27. What three cultural requirements are necessary to grow the best lettuce?
    a. Circular 160, p. 5.
    b. Bailey, p. 357.
    c. Wickson, p. 224.
28. What specific things will you do to get your ground ready for the sowing of the seed?
29. How will you irrigate your growing plants?
    a. Correspondence Course, Lesson 10, p. 11.
30. How can you tell when lettuce is ready to harvest?
    a. Correspondence Course, Lesson 10, p. 11, 12.
31. How will you market your crop?
32. Has it paid you to grow your lettuce?

X - The Melon (also Cucumber) Project.

A - For convenience the watermelon, muskmelon and the cucumber are all included in a single project. Bailey says: "There are no fundamental differences in the cultivation of the various cucurbitous crops. They are all very tender to frost and they usually grow, at least in the north, till overtaken by frost or disease". The watermelon is Citrullus vulgaris, a native of Africa. The muskmelon is Cucumis Melo, a native of Southern Asia. The Cucumber is Cucumis sativus, a native of southern Asia. They are all members of the great group Cucurbitaceae.

B - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.
3. Correspondence Course, Vegetable Gardening, by S. S. Rogers, College of Agriculture, University of California.

C - Outline Questions.

1. To what cultural class of plants do the melons belong?
    a. Bailey, p. 241.
2. What is the early history of the melon?
    a. Correspondence Course, Lesson 8, p. 8.
3. What is the early history of the cucumber?
    a. Correspondence Course, Lesson 12, p. 8.
4. What is the importance of the melon crop in California?
    a. Correspondence Course, Lesson8, p. 9.
    b. Wickson, p. 229.
5. What is the importance of the cucumber crop in California?
    a. Correspondence Course, Lesson 12, p. 9.
    b. Wickson, p. 220.
6. What are the general soil and climatic requirements for the melon plants?
    a. Bailey, p. 411, 412.

7. What are the cultural requirements for melons?
   a. Correspondence Course, Lesson 8, p. 10.
8. What are the cultural requirements for the cucumber?
   a. Correspondence Course, Lesson 12, p. 9.
   b. Wickson, p. 220.
9. Are the melon crops grown in drills or in hills?
10. How many hills of each will you grow?
11. What are the varieties of cucumbers?
   a. Wickson, p. 221.
   b. Correspondence Course, Lesson 12, p. 9.
12. What are the varieties of muskmelons?
   a. Wickson, p. 234, 235.
13. What are the varieties of watermelons?
   a. Wickson, p. 238.
14. What variety of cucumber will you grow?
15. What variety of muskmelon will you grow?
16. What variety of watermelon will you grow?
17. How much seed will you need of each?
18. What kind of soil and preparation for cucumbers?
   a. Wickson, p. 219.
19. What kind of soil and preparation for muskmelons?
   a. Wickson, p. 230.
20. What kind of soil and preparation for watermelons?
   a. Wickson, p. 236.
21. How are melons planted?
   a. Correspondence Course, Lesson 8, p. 10.
   b. Wickson, p. 237.
22. How are cucumbers planted?
   a. Wickson, p. 219.
23. When is the best time to plant melon and cucumber seed in your locality?
   a. Ask your most successful local grower.
24. Is irrigation needed for melons?
   a. Correspondence Course, Lesson 8, p.11.
   b. Wickson, p. 234.
25. How will you irrigate, if necessary?
   a. Correspondence Course, Lesson 8, p. 11 (bottom of page).
   b. Wickson, p. 233.
26. Why will you cultivate your vine crops?
27. How will you cultivate them?
28. What methods of cultivation does the most successful grower in your locality use?
29. What tools will you use in cultivation?
30. How often will you pick the cucumbers?
31. When is the best time to harvest melons?
   a. Correspondence Course, Lesson 8, p. 12.
32. How can you tell when a watermelon is ripe?
   a. Bailey, p. 418.
33. How will you market your crop?
34. What do you consider has been the value of your melon project to you?

XI - The Onion Project.

A - The project is limited to the growing of onions from seed sown in the place where the onions are to grow. The onion is a bulb and belongs to the same class as the lilies. Corbett in "Garden Farming" says:

"1. There is a general class of onions which produce normal black seed from which bulbs varying in size, color, shape and flavor may be produced. This constituted the great commercial class of onions grown from seed sown in place or sown in seed-beds and transplanted to the field.

"2. There is a second class of onions that normally reproduce themselves by segregation of the bulbs, somewhat in the same manner as garlic. This is the multiplier group. The potato onion, which belongs to this class, is quite hardy, requiring only a good mulch as a winter covering. It forms the stock for the main fall-planted crop grown for early bunchers at the North.

"3. A third class is also a set, or multiplier; but, instead of producing its increase by the breaking up of the mother bulb, a stalk corresponding to the blossom stalk in the common onion is produced, on top of which is formed a cluster of bulblets instead of the normal blossoms and seed."

B - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.
3. Correspondence Course in Onion Culture, by S. S. Rogers, College of Agriculture, University of California.
4. Farmers' Bulletin No. 354, Onion Culture, U. S. Dept. of Agriculture.

C - Outline Questions:

1. What are the different members of the onion family?
   a. Bailey, p. 314.
   b. Wickson, p. 240.
2. Which of these have you seen growing?
3. What do you know of the history of the onion?
   a. Correspondence Course, Lesson 1, p. 2.
   b. Farmers' Bulletin, No. 354, p. 5.
4. To what class of plants does the onion belong?
   a. Bailey, p. 314.
   b. Farmers' Bulletin 354, p. 5.
5. What is the importance of the onion crop in th United States?
   a. Farmers' Bulletin 354, p. 5, 6.
6. What is the importance of the onion crop in California?
   a. Wickson, p. 240, 241.
7. What are the varieties of onions suitable to California?
   a. Wickson, p. 250.
   b. Correspondence Course, Lesson 1, p. 4.
8. What are the colors included in the varieties?
9. Does the color of the onion affect its taste?
10. Which color do you prefer?
11. What are the principal yellow varieties?
12. What are the principal white varieties?
13. What are the principal red varieties?

14. What two varieties constitute the main part of the California product?
    a. Wickson, p. 250 (bottom).
15. Which variety will you grow from seed?
16. How many rows will you grow?
17. How long is each row?
18. How much seed will you need?
    a. Bailey, p. 326.
19. Where will you get your seed?
20. Why is it important to have good seed?
    a. Bailey, p. 321, 322.
21. Why and how test your onion seed?
    a. Correspondence Course, Lesson 1, p. 5.
22. What kind of soil is best suited to grow onions?
    a. Wickson, p. 241.
    b. Correspondence Course, Lesson 1, p. 2.
    c. Farmers' Bulletin 354, p. 7, 8.
23. What is the condition of your soil?
24. How prepare soil for growing onions?
    a. Wickson, p. 243.
    b. Correspondence Course, Lesson 1, p. 7, 8.
    c. Farmers' Bulletin 354, p. 9, 10, 11.
25. What particular things will you do to prepare your plot?
26. What tools will you need?
27. When will you begin work?
28. What crops did your soil grow last year?
29. Will you need to fertilize your soil?
30. What fertilizers are used for growing onions?
31. What is the value of stable manure?
    a. Correspondence Course, Lesson 2, p. 3, 4.
    b. Farmers' Bulletin 354, p. 11, 12.
32. What is the value of commercial fertilizers?
    a. Correspondence Course, Lesson 2, p. 4.
    b. Farmers' Bulletin 354, p. 12.
33. What is a good fertilizer "formula" for onion growing?
    a. Correspondence Course, Lesson 2, p. 5.
    b. Farmers' Bulletin 354, p. 13.
34. When is the best time to apply commercial fertilizers?
    a. Correspondence Course, Lesson 2, p. 6.
    b. Farmers' Bulletin 354, p. 13.
35. What is the most practical thing for you to do to enrich your soil for onion growing?
36. When will you plant your seed?
    a. Wickson, p. 243.
    b. Correspondence Course, Lesson 2, p. 6, 7.
    c. Farmers' Bulletin 354, p. 14.
37. What are important things in planting onion seed?
    a. Wickson, p. 243, 244.
    b. Correspondence Course, Lesson 2, p. 7, 8.
    c. Farmers' Bulletin 354, p. 14, 15.

38. What must be the character of the cultivation?
    a. Wickson, p. 244.
    b. Correspondence Course, Lesson 2, p. 8, 9.
    c. Farmers' Bulletin 354, p. 17, 18, 19.
39. What tools will you use in cultivation?
40. When and how will you thin your onions?
41. What is the best way of irrigating your onions, if necessary?
    a. Correspondence Course, Lesson 2, p. 9.
42. Do onions need much water?
43. When and why cultivate after each irrigation?
44. What is the disease "Downy Mildew" and its control?
    a. Correspondence Course, Lesson 5, p. 4.
    b. Farmers' Bulletin 354, p. 34, 35.
45. What is onion "smut" and how controlled?
    a. Farmers' Bulletin 354, p. 33, 34.
    b. Correspondence Course, lesson 5, p. 5.
46. What is the onion thrips?
    a. Correspondence Course, Lesson 5, p. 6.
47. What is a good spray for the control of the thrips?
    a. Correspondence Course, Lesson 5, p. 7.
48. How are cutworms controlled?
    a. Correspondence Course, Lesson 5, p. 7, 8.
49. How will you know when to harvest your onions?
    a. Wickson, p. 248.
    b. Correspondence Course, Lesson 3, p. 2.
50. What are the successive steps in harvesting onions?
    a. Wickson, p. 248.
    b. Correspondence Course, Lesson 3, p. 2, 3, 4.
    c. Farmers' Bulletin 354, p. 21, 22, 23.
51. What care should be observed in storing onions?
    a. Correspondence Course, Lesson 3, p. 4, 5, 6.
    b. Farmers' Bulletin 354, p. 24, 25, 26.
52. What market have you for your onions?
53. How will you grade them for market?
54. What has it cost you to grow your onions?
55. What items will you include in your final report?

XII - The Pea Project.

A - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.
3. Correspondence Course in Vegetable Gardening, by S. S. Rogers, College of Agriculture, University of California.

B - Outline Questions:

1. To what cultural class of plants does the pea belong?
    a. Bailey, p. 241.
2. What is the history of the pea?
    a. Bailey, p. 382.
    b. Correspondence Course, Lesson 11, p. 6.
3. What three kinds of peas are grown?
    a. Bailey, p. 382.
4. What varieties of peas are grown in California?
    a. Wickson, p. 256, 257.

5. Which of these varieties have you seen growing?
6. How important is the growing of peas in California?
   a. Correspondence Course, Lesson 11, p. 7.
   b. Wickson, p. 304.
7. What variety will you grow in your garden?
8. How many rows will you grow?
9. How much seed will you need?
   a. Bailey, p. 382.
   b. Any good seed catalogue
10. What kind of soil is best for peas?
   a. Wickson, p. 254.
   b. Bailey, p. 381.
   c. Correspondence Course, Lesson 11, p. 7.
11. What kind of soil in your garden?
12. How can you improve it for peas?
13. When will you plant your peas?
   a. Wickson, p. 255.
   b. Correspondence Course, Lesson 11, p. 8.
14. How will you plant them?
   a. Bailey, p. 382.
   b. Wickson, p. 255.
   c. Correspondence Course, Lesson 11, p. 8.
15. How will you cultivate your crop?
   a. Correspondence Course, Lesson 11, p. 8.
   b. Wickson, p. 254.
16. What climatic conditions are best for peas?
   a. Bailey, p. 380.
   b. Wickson, p. 253.
   c. Correspondence Course, Lesson 11, p. 7.
17. How often will you irrigate your peas?
18. How control the mildew on the vines?
   a. Correspondence Course, Lesson 11, p. 9.
19. How control the aphis?
   a. Correspondence Course, Lesson 11, p. 9.
20. What is meant by a leguminous plant?
21. Is the pea a "legume"?
22. Why is a pea called a "pulse" crop?
23. How can you tell when to harvest your peas?
24. What will you do with your crop?
25. How are peas sold?
26. What was the cost of your labor and the seed in growing your crop?
27. How much money did you receive?
28. What items of special interest will you include in your final report?

XIII - The Potato Project.

A - The potato - and other vegetables to a greater or less extent - permits of two kinds of projects. First, the "productive" project, the growing of the best yield possible of marketable potatoes and the marketing of the same at the best price. Second, the "improvement" or "experiment" project by seed selection etc., to get a better type of potatoes. The "growing" or "productive" project

is completed in a single season. The "improvement" or "experiment" project requires several seasons and is a most valuable exercise. As in the case of the bean, the project in area may be a few rows in the garden or an half acre or vacant lot cultivated under regular field conditions. Suggestive outlines on both the "productive" and "experiment" potato projects here follow.

B - References:

1. Circular No. 161, Potatoes in California, by J. W. Gilmore, College of Agriculture, University of California.
2. Correspondence Course in Vegetable Gardening, by S. S. Rogers, College of Agriculture, University of California.
3. Wickson, California Vegetables in Garden and Field.
4. Bailey, The Principles of Vegetable Gardening.
5. Farmers' Bulletin No. 35, Potato Culture, U. S. Dept. of Agriculture.
6. Farmers' Bulletin No. 386, Potato Culture in Irrigated Farms of the West, U. S. Dept. of Agriculture.
7. Farmers' Bulletin No. 407, The Potato as a Truck Crop, U. S. Dept. of Agriculture.
8. Farmers' Bulletin No. 533, Good Seed Potatoes and How To Produce Them, U. S. Dept. of Agriculture.
9. Farmers' Bulletin No. 557, The Potato-Tuber Moth, U. S. Dept. of Agriculture.
10. Farmers' Bulletin No. 847, Potato Storage and Storage Houses, U. S. Dept. of Agriculture.

C - Outline Questions in the "Productive" Potato Project.

1. Who grows the best potatoes in your district?
2. What varieties of potatoes does he grow?
3. What are the best soil conditions to grow potatoes?
   a. Circular 161, p. 1.
   b. Correspondence Course, Lesson 6, p. 3.
   c. Wickson, p. 265.
   d. Bailey, p. 301.
   e. Bulletin No. 35, p. 3.
4. How prepare the soil for best results?
   a. Circular 161, p. 2.
   b. Correspondence Course, Lesson 6, p. 4.
   c. Wickson, p. 44, 45, 46.
   d. Bulletin No. 35, p. 4.
   e. Bulletin No. 386, p. 5.
5. How does the best grower in your district prepare his soil?
6. Will you visit him and ask him some questions?
7. What questions will you ask?
8. How large a plot of ground will you grow to potatoes?
9. What was grown on it last year?
10. What things will you do to get the best possible seed-bed?
11. When will you begin?
12. When will you begin to consider the seed you will plant?
13. What varieties grow well in your locality and in California?
    a. Circular 161, p. 7, 8.
    b. Correspondence Course, Lesson 6, p. 11.
    c. Wickson, p. 269.
    d. The best local grower of potatoes:

14. What constitutes good seed potatoes?
    a. Bulletin No. 533, p. 6.
15. How will you prepare the seed for planting?
    a. Circular 161, p. 2, 3, 4.
    b. Correspondence Course, Lesson 6, p. 6.
    c. Wickson, p. 266.
    d. Bulletin 35, p. 8, 9.
    e. Bulletin 386, p. 7.
    f. Bulletin 407, p. 13, 14.
    g. Bailey, p. 304, 305.
    h. Bulletin 533, p. 10.
    i. Your best local grower.
16. When weill you plant your potatoes?
    a. Circular 616, p. 4.
    b. Correspondence Course, Lesson 6, p. 5.
    c. Wickson, p. 264, 265.
    d. Bailey, p. 301.
17. What constitutes good cultivation of potatoes?
    a. Circular 161, p. 5.
    b. Correspondence Course, Lesson 6, p. 8.
    c. Wickson, p. 266.
    d. Bailey, p. 302.
    e. Bulletin 386, p. 7.
    f. Bulletin 407, p. 16, 17.
    g. Bulletin 35, p. 18, 19.
18. If necessary to irrigate your potatoes, how will you do it?
    a. Circular 161, p. 5.
    b. Correspondence Course, Lesson 6, p. 7.
    c. Wickson, p. 267.
    d. Bulletin 386, p. 8.
    e. Practice of best local grower.
19. To what class of plants does the potato belong?
20. What other plants do you know that belong to the same family?
21. What characteristics have they in common?
22. What kind of stem and leaf has the potato plant?
23. What kind of flower has the potato plant?
24. Have you ever seen any potato "seed"?
25. What is the history of the potato?
26. How will you protect the potato plants from insect enemies and diseases?
    a. Circular 161, p. 5, 6, 7.
    b. Correspondence Course, Lesson 6, p. 11, 12, 13.
    c. Bailey, p. 304.
    d. Bulletin 557, p. 1, 2, 3.
    e. Bulletin 407, p. 13 and 17, 18.
27. When and how will you harvest your potatoes?
    a. Correspondence Course, Lesson 6, p. 9, 10.
    b. Wickson, p. 268.
    c. Bulletin 407, p. 20, 21.
28. How will you store and market your potatoes?

a. Wickson, p. 268.
b. Correspondence Course, Lesson 6, p. 10.
c. Bulletin 386, p. 9, 10.
d. Bulletin 407, p. 22, 23, 24.
e. Bulletin 847, p. 9, 12, 16.

29. What items enter into the cost of growing potatoes?
a. Circular 161, p. 8.
b. Correspondence Course, Lesson 6, p. 3.

30. What has it cost you to grow your plot of potatoes?
31. What mistakes have you made in the management of your project?
32. What items will you include in your final written report?
a. Bulletin 35, p. 21, 22, 23.
33. How will you prepare an exhibit of your potatoes for the local fair?

D - Outline Questions in the "Improvement" or "Experiment" Potato Project.

1. Do you know what is meant by plant improvement?
2. Do you know of anyone who has improved plants?
3. What are some of the things that were done?
4. How was the Burbank potato produced?
5. What is meant by a "good environment" for a plant that is to be improved?
6. How large a plot of ground will you have for your "improvement" potato project?
7. What climatic conditions will you consider for your "improvement" work?
8. What soil conditions will you study to make the best possible home for the potato plants you will try to improve?
9. What will you do to secure your first or "foundation" seed to grow the potato plants you expect to improve?
a. Bulletin 533, p. 6 (Very important).
b. Ask some local grower who has made some improvement by this first seed selection.
10. Do you know what is meant by the "Tuber-Unit Method" of developing high-grade seed potatoes?
a. Bulletin 533, p. 11. (Also very important).
11. Will you make a record by a photograph or written description of the best tubers you have selected?
12. Why will this record be valuable when you harvest the first potatoes from your improvment plot?
13. Will you draw a diagram of your improvment plot so you may know what particular hills are growing from a particular tuber seed?
14. What is meant by "seed selection from productive plants?"
15. What is meant by the "Hill-Selection Method" of securing good seed potatoes? Bulletin 533, p. 12 (Important).
16. How will you make your "hill-selection"?
17. How will you select seed for the second year improvement plot?
18. What are the requirements for success? Bulletin 533, p. 6, p. 16, (Important).
19. What records will you keep of individual potatoes, of particular hills, of entire plot in general?

XIV - The Radish Project.

A - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.

B - Outline Questions.

1. What are the three general types of radishes?
   a. Bailey, p. 273, 274.
2. Which of these have you seen growing?
3. What is the history of the radish?
   a. Bailey, p. 276.
4. What varieties of radishes are grown in California?
   a. Wickson, p. 275.
   b. Any good seed catalogue.
5. What varieties will you grow?
6. Will you grow winter as well as spring radishes?
7. How many rows will you grow?
8. How much seed will you need?
   a. Bailey, p. 276.
   b. Any good seed catalogue.
9. How often will you sow the seed?
10. What is meant by seed selection?
    a. Bailey, p. 275.
11. Will it pay you to take time to select your seed?
12. What is meant by growing the radish as a companion crop?
    a. Bailey, p. 274.
    b. Wickson, p. 275.
13. What are the prime considerations in growing radishes?
    a. Bailey, p. 273.
14. What kind of soil is best for radishes?
    a. Wickson, p. 274.
15. How will you put your soil in good condition?
    a. Wickson, p. 274.
16. How will you sow your radish seed?
    a. Bailey, p. 276.
    b. Any good seed catalogue.
17. How will you cultivate?
18. Will you irrigate?
19. Did you ever see the flower of the radish plant?
20. How can you grow radish seed?
    a. Bailey, p. 276.
21. How control the root maggot?
    a. Bailey, p. 275.
22. How are radishes prepared for the market?
23. How many bunches did you sell?
24. In what ways has the growing of radishes been worth your while?

XV - The Spinach Project.

A - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.
3. Circular Feb., 1918- Spinach Growing in California, by S. S. Rogers College of Agriculture, University of California.

B - Outline Questions.

1. What is the importance of spinach growing in California?
   a. Circular - Spinach Growing, p. 1.
2. When can it be grown in California?
   a. Wickson, p. 280.
3. To what cultural class of plants does spinach belong?
   a. Bailey, p. 241.
4. What is the botanical classification of spinach?
   a. Bailey, p. 350.
5. What kind of soil is best suited to spinach?
   a. Circular - Spinach Growing, p. 2.
   b. Wickson, p. 281.
6. What moisture and climatic conditions most favorable?
   a. Circular - Spinach Growing, p. 2.
   b. Wickson, p. 280.
7. What varieties of spinach are grown?
   a. Circular, Spinach Growing, p. 3.
   b. Wickson, p. 281.
   c. Bailey, p. 350.
8. What is said of the New Zealand spinach?
   a. Wickson, p. 281.
   b. Bailey, p. 350, (bottom).
9. How prepare the soil for spinach growing?
   a. Circular - Spinach Growing - p. 2.
   b. Bailey, p. 348.
10. When is a good time to plant spinach seed in California?
    a. Circular - Spinach Growing - p. 2.
    b. Wickson, p. 280.
11. Which variety of spinach will you grow?
12. How much will you grow?
13. How much seed will you need?
    a. Bailey, p. 350.
    b. Any good seed catalogue.
14. How will you sow your seed?
    a. Circular - Spinach Growing, p. 2, 3.
    b. Bailey, p. 350.
15. What cultivation is required in the growing of spinach?
    a. Circular - Spinach Growing, p. 3.
16. How will you cultivate your crop?
17. Will you irrigate your plants?
18. How is spinach harvested?
    a. Circular - Spinach Growing, p. 2.
19. Can you pick off the leaves without cutting down the plant?
20. Will the leaves grow out again?
21. What items will you include in your report?

XVI - The Squash (also Pumpkin) Project.

A - The cultural requirements of these two vegetables are quite similar. Often the question is asked, "What is the difference between a pumpkin and a squash?" Botanically, Corbett in his "Garden Farming" classifies the squash family as follows: "The important varieties of the garden squashes belong to three species, which as known as Cucurbita maxima. Cucurbita pepo and Cucurbita moschata. Of these, the first, Cucurbita

maxima, is perhaps the most important. To this belong the "long-keeping" varieties, which are richest and finest in flavor. Next to it in importance from the market gardener's standpoint is Cucurbita pepo; to this species belong the scallop, bush, or summer squash, the field pumpkin of the north, and the cymling of the south. Of the so-called summer squash, or Cucurbita pepo, there are a number of types, the most important of which are the summer crookneck and the scallop and pattypan squashes, also called cymlings.

The third type is the Canada crookneck, Cucurbita moschata. The moschata group is chiefly valuable for its use as a pie filling. It is also known as the pie pumpkin".

B - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.
3. Correspondence Course in Vegetable Gardening, by S. S. Rogers, College of Agriculture, University of California.

C - Outline Questions.

1. To what cultural class of plants does the squash belong?
   a. Bailey, p. 241-242.
2. What is the importance of the squash and pumpkin in California?
   a. Correspondence Course, Lesson 14, p. 2,3.
   b. Wickson, p. 282.
3. Where may they be grown in California?
4. What varieties of the squash are grown?
   a. Correspondence Course, Lesson 14, p. 3, 4.
   b. Wickson, p. 285.
5. What varieties of pumpkin are grown?
   a. Correspondence Course, Lesson 14, p. 3.
6. Will you grow winter and summer squash?
7. What variety will you grow?
8. What variety does best in your locality?
   a. Ask some successful grower.
9. What variety of pumpkin will you grow?
10. How much seed will you need?
    a. Bailey, p. 420.
    b. Any good seed catalogue.
11. How many hills of each will you grow?
12. How much ground is needed for a single hill?
13. How will you plant the seed?
    a. Bailey, p. 420.
    b. Wickson, p. 283, (bottom page).
    c. Correspondence Course, Lesson 14, p. 2.
14. When may you plant the seed?
    a. Correspondence Course, Lesson 14, p. 2.
    b. Wickson, p. 283.
15. What kind of soil is best for squash and pumpkin?
    a. Wickson, p 283.
    b. Correspondence Course, Lesson 14, p. 2.
16. What kind of soil is yours?
17. What will you do to get your soil ready for the crop?
18. What cultivation will you give to the growing crop?
    a. Correspondence Course, Lesson 14, p. 3.
    b. Wickson, p. 285.

19. How many kinds of flowers on the vines?
20. Do you know the name of each kind?
21. How can you distinguish them?
22. Which blossom bears the fruit?
23. What is a pistillate flower?
24. What is a staminate flower?
25. Is the pumpkin or the squash a wind-pollinated or insect-pollinated plant?
26. What is the special name for the "fruit"?
    a. Bailey's Elementary Botany for answers to questions 19-26.
27. Will you irrigate your crop?
    a. Wickson, p. 285.
28. Can you grow pumpkins without irrigation?
29. On what kind of soil?
30. If without irrigation, what preparation of the soil before planting the seed?
31. When will you harvest your crop?
    a. Correspondence Course, Lesson 14, p. 3.
32. Will Cucurbita pepo and Cucurbita maxima, that is, will pumpkins and squash "cross" if planted side by side?
    a. Bailey, p. 421.
33. What is meant by "cross"?
34. Will different varieties of corn "cross" if planted side by side?
35. How will you dispose of your crop of pumpkin or squash?
36. What is the weight of the largest of each?
37. What items will you include in your final report?

XVII - The Tomato Project.

A - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, California Vegetables in Garden and Field.
3. Correspondence Course in Vegetable Gardening, by S. S. Rogers, College of Agriculture, University of California.
4. Circular No. 147, Tomato Growing in California, by S. S. Rogers, College of Agriculture, University of California.
5. Farmers' Bulletin No. 22, Tomatoes, U. S. Dept. of Agriculture.

B - Outline Questions:

1. To what class of crops does the tomato belong?
    a. Bailey, p. 392.
2. What is the history of the tomato?
    a. Bulletin No. 220, p. 5.
    b. Correspondence Course, Lesson 8, p. 2.
3. How important is the tomato in California?
    a. Circular No. 147, p. 1.
    b. Correspondence Course, Lesson 8, p. 2.
4. Where can it be grown?
    a. Wickson, p. 286.
5. What are the best varieties?
    a. Wickson, p. 293.
    b. Correspondence Course, Lesson 8, p. 6.
    c. Circular No. 147, p. 8.
    d. A successful local grower.

6. Where will you procure your seed?
7. How much seed will you need?
8. How many good, healthy plants will you need?
9. How large a plot will you grow?
10. How far apart are tomato plants in the ground?
    a. Correspondence Course, Lesson 8, p. 4.
    b. Bailey, p. 396.
    c. A successful local grower.
11. How far apart will you set your plants?
12. How are tomato plants grown from seed?
    a. Circular No. 147, p. 4.
    b. Wickson, p. 289, 290.
    c. Bailey, p. 393.
13. What is the specific way you will grow your plants?
14. When will you start the seed to growing?
15. What kind of soil is best for tomatoes?
    a. Correspondence Course, Lesson 8, p. 3.
    b. Circular No. 147, p. 2.
    c. Wickson, p. 288.
    d. Bailey, p. 394.
16. What kind of soil have you?
17. How is the soil prepared for the plants?
    a. Circular No. 147, p. 3.
    b. Wickson, p. 291.
18. What care should you take in transplanting?
    a. Wickson, p. 291.
    b. Circular No. 147, p. 6.
19. When will you set the plants out?
20. What cultivation will you give your crop?
    a. Circular No. 147, p. 6.
    b. Correspondence Course, Lesson 8, p. 5.
    c. Wickson, p. 292.
    d. A successful local grower.
21. What irrigation will you give?
    a. Correspondence Course, Lesson 8, p. 5.
    b. Circular No. 147, p. 6.
    c. Wickson, p. 292.
22. When is it undesirable to apply water?
    a. Circular No. 147, p. 7.
23. Will you train any of your plants on stakes or frames?
    a. Bailey, p. 395.
24. Will you prune any of your growing plants?
    a. Wickson, p. 292.
    b. Bailey, p. 398.
25. What are the advantages of training and pruning?
26. What things of interest do you observe in the growing plants?
27. What color is the tomato flower?
28. How does it compare with the potato flower?
29. What are the diseases of the tomato?
    a. Circular No. 147, p. 9, 10, 11.
    b. Correspondence Course, Lesson 8, p. 7, 8.
30. How will you harvest your crop?

31. What special care will you take in preparing them for market?
    a. Circular No. 147, p. 7, 8.
    b. Bulletin No. 220, p. 13, 14.
    c. Wickson, p. 292.
32. What is the total yield of your crop in pounds?
33. What has been the cost of growing your crop?

XVIII - The Turnip (also Kohlrabi) Project.

A - The treatment of these two vegetables is the same. The Kohlrabi is sometimes called the "Turnip above ground". It is an excellent vegetable if used early in its growth when the bulb is about 2 inches in diameter. Botanically they belong to the same family. Bailey classifies as follows: "The cole plants (known to the French under the generic name of chow) are probably derivatives of one European sea-coast species, Brassica oleracea. It belongs to the Cruciferae or mustard family. The plant is perennial and now grows on the cliffs of Southern England and other parts of Europe. The wild cabbage is very like a tall kale. The cultivated offspring are mostly biennial. The types may be arranged as follows:-

Brassica oleracea, wild or original form.
Brassica oleracea acephala, Kale.
Brassica oleracea gemmifera, Brussels sprouts.
Brassica oleracea capitata, Cabbage.
Brassica oleracea botrytis, Cauliflower.
Brassica oleracea caulo-rapa, Kohlrabi.
Brassica oleracea rapa, Turnip".

B - References:

1. Bailey, The Principles of Vegetable Gardening.
2. Wickson, The California Vegetables in Garden and Field.
3. Correspondence Course in Vegetable Gardening, by S. S. Rogers, College of Agriculture, University of California.

C - Outline Questions:

1. How long has the turnip been cultivated?
    a. Correspondence Course, Lesson 11, p. 5.
2. To what cultural class of plants does it belong?
    a. Bailey, p. 240.
    b. Wickson, p. 295.
3. How do the turnip and Kohlrabi rank as vegetables?
    a. Wickson, p. 294.
4. Is it worth your while to grow a few in your garden?
5. What varities of turnip are grown?
    a. Wickson, p. 296.
6. What variety of Kohlrabi is grown?
    a. Wickson, p. 296.
    b. Any good seed catalogue.
7. How much seed will you need?
8. Where will you get your seed?
9. How are turnip seed sown?
    a. Bailey, p. 286.
10. How is Kohlrabi grown?
    a. Wickson, p. 295, (bottom).

11. What is the value of the turnip (also kohlrabi) as food?
    a. Bailey, p. 285, 286.
12. What is the culture method for these two vegetables?
    a. Wickson, p. 295.
13. What kind of soil is needed?
14. How will you prepare your soil?
15. What methods of cultivation will you use?
16. Will you irrigate?
17. How are you to know when is the best time to harvest?
18. How large should the young turnip or Kohlrabi be to taste well?
19. How will you find out?
20. What will happen to the quality if grown too large?
21. How long will it take to grow roots large enough for the table?
    a. Bailey, p. 285.
22. How control the turnip maggot?
    a. Bailey, p. 286.
23. Was it worth while to include these two vegetables in your garden work?
24. What have you learned?

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THE PLANT

(In connection with growing of plants in the garden).

A - References for Study:

1. Bailey, Botany - An Elementary Text for Schools.

"The ninety and nine cannot and should not be botanists, but everyone can love plants and nature. Every person is interested in the evident things, few in the abstruse and recondite. Education should train persons to live rather than be scientists" - Bailey.

2. Coulter, Plant Life and Plant Uses, An Elementary Textbook, a foundation for the study of Agriculture, Domestic Science or College Botany.

"The book seeks to give its reader a certain appreciation of plants and of the relationship of plant life to his own life. The study of "botany" may or may not yield such appreciation. Boys and girls, by mere accumulation of "organized knowledge about plants" may never come to that appreciation of plants as a part of life which is believed to be very desirable, and one of the proper ends of the study of plants". - Coulter.

B - Outline Questions for Study:

I - Introduction.

1. How are plants important to man?
    a. Coulter, p. 1-10.
2. What two great changes are taking place in plant life?
    a. Coulter, p. 12.
3. What is it that makes Agriculture a science?
    a. Coulter, p. 16.
4. What must the successful farmer know about plants?
    a. Coulter, p. 17.

5. What five reasons are given for studying plants?
   a. Coulter, p. 19, 20.
6. What two ways of studying plants?
   a. Coulter, p. 21, 22.
7. What is the plant?
   a. Bailey, p. 1.
   b. Coulter, p. 38.
8. What are the chief ends of plant life?
   a. Coulter, p. 39.
9. What are the three great functions of living things?
   a. Coulter, p. 45.
10. What are the parts of the plant?
   a. Bailey, p. 1.
11. What does the life history of the plant include?
   a. Bailey, p. 2.
12. What is the meaning of "generation" as applied to a plant?
   a. Bailey, p. 2, 3.
13. What causes changes in plants?
   a. Bailey, p. 5.
14. What does every plant try to do?
   a. Bailey, p. 5.
15. What is the "wild" plant?
16. What is the "domestic" plant?
17. What plants are undesirable?
18. Why should we grow plants?
19. How can we assist nature to improve plants?
20. How many plants do you know by sight?

II - The Root.

1. What do we mean by the roots of the plant?
   a. Coulter, p. 45.
2. Of what use are the roots to the plant?
   a. Coulter, p. 46, 47.
   b. Bailey, p. 7.
3. What is meant by the root system?
   a. Bailey, p. 7.
4. What is the tap-root?
   a. Bailey, p. 7.
   b. Coulter, p. 125.
5. What is the fibrous root?
   a. Bailey, p. 7.
   b. Coulter, p. 125.
6. Upon what does the shape and extent of the root system depend?
   a. Bailey, p. 7, 8.
7. Why are roots crooked?
   a. Coulter, p. 131.
8. Why is it important to the farmer to know the root characteristics of the plants he grows?
9. What is meant by the expression "feeding roots"?
   a. Bailey, p. 8.

10. How can we develop the "feeding roots" of the plant?
11. Where is the "feeding surface" of the root?
    a. Bailey, p. 9.
12. What are the root-hairs and where are they found?
    a. Bailey, p. 9, 10.
    b. Coulter, p. 135.
13. Have you ever seen root-hairs?
14. If not, will you sprout some radish seed so you may?
15. How will you sprout the radish seed?
    a. Bailey, p. 13.
16. Why can you not see root-hairs when you pull a root from the ground?
    a. Coulter, p. 137.
17. What are aerial roots?
    a. Bailey, p. 10.
18. What are brace roots?
    a. Bailey, p. 12.
19. How do roots grow in length?
    a. Bailey, p. 17.
    b. Coulter, p. 130, 131.
20. What is the root-cap?
    a. Coulter, p. 134, 135.
    b. Bailey, p. 267.

III - The Stem.

1. What is the stem of a plant?
    a. Bailey, p. 14.
    b. Coulter, p. 49.
2. What is the "habit" of a plant?
    a. Bailey, p. 14.
3. What are some of the uses of stems to man?
    a. Coulter, p. 52.
4. What is an erect stem?
    a. Bailey, p. 15.
    b. Coulter, p. 146, 147.
5. What is an excurrent stem in trees?
    a. Bailey, p. 15.
    b. Coulter, p. 148.
6. What is the deliquescent stem in trees?
    a. Bailey, p. 15.
    b. Coulter, p. 148.
7. What is the prostrate stem?
    a. Coulter, p. 149.
8. On what kind of soil are prostrate stems abundant?
    a. Coulter, p. 150.
9. What advantages do prostrate stems have?
    a. Coulter, p. 150.
10. What is the climbing stem?
    a. Coulter, p. 151, 152.
11. How do climbing stems attach themselves to their supports?
    a. Coulter, p. 152, 153.

12. What are underground stems?
    a. Coulter, p. 155.
13. How does a stem grow longer?
    a. Bailey, p. 17.
14. What are the nodes and the internodes of a stem?
    a. Coulter, p. 50.
15. What is an endogenous stem?
    a. Bailey, p. 259.
    b. Coulter, p. 171, 172.
16. What is plant tissue?
    a. Coulter, p. 77.
    b. Bailey, p. 252.
17. What is epidermal tissue?
    a. Bailey, p. 254.
    b. Coulter, p. 77.
18. What is fibrous tissue?
    a. Bailey, p. 255.
19. What is vascular tissue?
    a. Bailey, p. 256.
20. What is the fibro-vascular tissue system?
    a. Bailey, p. 257.
21. What is the fundamental tissue system?
    a. Bailey, p. 257, 252.
22. What is the epidermal tissue system?
    a. Bailey, p. 258.
23. Of what two parts is every fibro-vascular bundle made?
    a. Bailey, p. 261.
24. What is an exogenous stem?
    a. Bailey, p. 260.
25. What is meristem tissue?
    a. Coulter, p. 163.
26. What is parenchyma tissue?
    a. Coulter, p. 164.
27. What is the stele of a stem?
    a. Coulter, p. 79, p. 163.
28. In stems how are the tissues of the stele organized?
    a. Coulter, p. 165.
29. What is the xylem of a vascular bundle?
    a. Coulter, p. 79 (last line).
30. What is thephloem of a vascular bundle?
    a. Coulter, p. 80, p. 165.
31. What are the tracheary vessels of a stem?
    a. Coulter, p. 173.
32. Why are dead tracheary vessels of more service to a plant than live ones?
    a. Coulter, p. 175.
33. What are the most important conducting cells of the phloem or bast?
    a. Coulter, p. 175.

34. What is meant by the mechanical tissue of a stem?
    a. Coulter, p. 147, 176.
35. What is meant by the conductive tissue of a stem?
    a. Coulter, p. 176.
36. What is the cambium of a growing stem?
    a. Bailey, p. 262.
    b. Coulter, p. 168.
37. What is the bark of a stem?
    a. Bailey, p. 265.
    b. Coulter, p. 178, 179, 180.

IV - The Bud.

1. What is the bud?
    a. Coulter, p. 185.
2. What is the winter bud?
    a. Bailey, p. 36.
    b. Coulter, p. 185.
3. What is the dormant bud?
    a. Bailey, p. 36, 54.
    b. Coulter, p. 189.
4. How is the bud protected?
    a. Bailey, p. 36.
    b. Coulter, p. 186.
5. What are the different kinds of buds?
    a. Coulter, p. 186.
6. What is an axillary bud?
    a. Bailey, p. 37.
    b. Coulter, p. 187.
7. What is the terminal bud?
    a. Bailey, p. 37.
8. What is an accessory bud?
    a. Bailey, p. 37.
    b. Coulter, p. 188.
9. What is an adventitious bud?
    a. Coulter, p. 188.
    b. Bailey, p. 54.
10. What is the leaf bud?
    a. Bailey, p. 39.
11. What is the fruit bud?
    a. Bailey, p. 39.
12. What is the mixed bud?
    a. Bailey, p. 40.
13. How distinguish the leaf bud from the fruit bud?
    a. Bailey, p. 40.
14. Why are the buds protected by scales?
    a. Coulter, p. 189.
15. What are the scales of the buds?
    a. Bailey, p. 107.

V - Leaves.

1. What are leaves?
    a. Coulter, p. 201.
    b. Bailey, p. 90.

2. What are the parts of the leaf?
   a. Bailey, p. 92.
   b. Coulter, p. 53.
3. What is the shape of leaves?
   a. Bailey, p. 93, 94.
   b. Coulter, p. 206, 207.
4. What kinds of venation of leaves?
   a. Bailey, p. 91.
   b. Coulter, p. 204, 205, 206.
5. What are the terms describing the attachment of leaves?
   a. Coulter, p. 208, 209.
   b. Bailey, p. 92, 93.
6. How are leaves arranged on the stem?
   a. Coulter, p. 210, 211, 212.
7. What is the character of the surface of the leaf?
   a. Coulter, p. 212.
8. What is the "bloom" on the leaf?
   a. Coulter, p. 212.
9. When is a plant surface "pubescent"?
   a. Coulter, p. 213, 214.
10. What is meant by "foliage area"?
   a. Coulter, p. 218.
11. What is the function or work of leaves?
   a. Bailey, p. 90.
12. What is meant by transpiration?
   a. Bailey, p. 81.
   b. Coulter, p. 219.
13. What are the three uses of water to the plant?
   a. Coulter, p. 225.
14. How much water is transpired by the plant?
   a. Bailey, p. 82.
15. What causes a plant to wilt?
   a. Bailey, p. 83, 84.
16. What influence does water exert upon plants?
   a. Coulter, p. 220.
17. What are the disadvantages of transpiration?
   a. Coulter, p. 221.
18. What are the advantages of transpiration?
   a. Coulter, p. 222.
19. What is the process of respiration in plants?
   a. Coulter, p. 225.
   b. Bailey, p. 80.
20. Where does the oxygen enter the plants?
   a. Bailey, p. 81.
   b. Coulter, p. 226.
21. Of what importance is the aeration of roots?
   a. Coulter, p. 226.
22. What is meant by oxidation?
   a. Coulter, p. 227.
23. What is the meaning of the word "photosynthesis"?
   a. Coulter, p. 43, p. 233 (bottom).
24. How is starch manufactured in the leaves?
   a. Bailey, p. 76, 77.

b. Coulter, p. 228, 229, 230, 231, 232.

25. What is the importance of a green leaf?
    a. Coulter, p. 55.
26. What is the meaning of the term "digestion" as applied to plants?
    a. Coulter, p. 42.
    b. Bailey, p. 79.
27. How is the digested food distributed?
    a. Bailey, p. 79, 80.
28. What is meant by "Gaseous Exchanges" in plants?
    a. Coulter, p. 233, 234.
29. What is the character of the epidermis of the leaf?
    a. Bailey, p. 270.
    b. Coulter, p. 234.
30. What are some of the outgrowths of the epidermis?
    a. Bailey, p. 270.
31. What are the stomates of the leaf?
    a. Bailey, p. 271.
    b. Coulter, p. 235, 236, 237.
32. What is the mesophyll of the leaf?
    a. Coulter, p. 237.
33. What are the two parts of the mesophyll?
    a. Coulter, p. 238.
    b. Bailey, p. 269.
34. Why does the leaf fall?
    a. Bailey, p. 271, 272.
    b. Coulter, p. 242, 243.
35. What is the cause of the autumnal color of leaves?
    a. Bailey, p. 225, 226.
    b. Coulter, p. 246, 247.

VI - The Flower.

1. What is the purpose of the flower?
    a. Bailey, p. 122.
2. What are the floral envelopes?
    a. Bailey, p. 122.
3. What is the calyx?
    a. Bailey, p. 122.
    b. Coulter, p. 59.
4. What is the corolla?
    a. Bailey, p. 122.
    b. Coulter, p. 59.
5. What is the sepal?
    a. Bailey, p. 122.
    b. Coulter, p. 59.
6. What is the petal?
    a. Bailey, p. 123.
    b. Coulter, p. 59.
7. What are the essential organs of a flower?
    a. Bailey, p. 123.
8. What is the stamen?
    a. Bailey, 124.
    b. Coulter, p. 60.

9. What is the pistil?
   a. Bailey, p. 124, 125.
   b. Coulter, p. 60, 61.
10. What is the staminate flower?
   a. Bailey, p. 125.
11. What is the pistillate flower?
   a. Bailey, p. 125.
12. What are flowers?
   a. Coulter, p. 258.
13. What is pollination?
   a. Bailey, p. 129.
   b. Coulter, p. 262.
14. By what two agencies are flowers pollinated?
   a. Coulter, p. 263.
   b. Bailey, p.131, 132.
15. What is self-pollination of flowers?
   a. Coulter, p. 263.
   b. Bailey, p. 128.
16. What is cross-pollination of flowers?
   a. Coulter, p. 263.
   b. Bailey, p. 128.
17. What is fertilization of flowers?
   a. Bailey, p. 128.
   b. Coulter, p. 275.
18. How are some flowers constructed to insure cross-pollination?
   a. Bailey, p. 130.
19. What is wind pollination?
   a. Bailey, p. 132.
   b. Coulter, p. 307.
20. What is insect pollination?
   a. Bailey, p. 131.
   b. Coulter, p. 309, 310.
21. Why do insects visit flowers?
   a. Coulter, p. 310, 311.
22. What is the simplest flower?
   a. Coulter, p. 280.
23. What are the flowers of the corn?
   a. Coulter, p. 282.
24. What is the bract?
   a. Coulter, p. 298.
   b. Bailey, p. 106.
25. What is the involucre?
   a. Coulter, p. 298.
   b. Bailey, p. 140.
26. What is the pedicel?
   a. Coulter, p. 298.
   b. Bailey, p. 120.
27. What is the peduncle?
   a. Coulter, p. 299.
   b. Bailey, p. 119.

28. What is the spike?
    a. Coulter, p. 299.
    b. Bailey, p. 116.
29. What is the catkin?
    a. Coulter, p. 299.
    b. Bailey, p. 116.
30. What is the raceme?
    a. Coulter, p. 299.
    b. Bailey, p. 115.
31. What is the panicle?
    a. Coulter, p. 300.
    b. Bailey, p. 117.
32. What is the corymb?
    a. Coulter, p. 302.
    b. Bailey, p. 117.
33. What is the umbel?
    a. Coulter, p. 300.
    b. Bailey, p. 117.
34. What is the head?
    a. Coulter, p. 300
    b. Bailey, p. 116.
35. What is the solitary flower?
    a. Bailey, p. 115.
36. What is a complete flower?
    a. Bailey, p. 125.
37. What is a sterile flower?
    a. Bailey, p. 126.
38. What is a perfect flower?
    a. Bailey, p. 126.
39. What is the perianth?
    a. Coulter, p. 271.
40. What are the parts of the stamen?
    a. Coulter, p. 272.
41. What are the parts of the pistil?
    a. Coulter, p. 272, 273.
42. What is the structure of the ovule?
    a. Coulter, p. 276.

VII - The Seed (or Fruit).

1. What is the fruit?
    a. Bailey, p. 147.
    b. Coulter, p. 62.
2. What is the simplest kind of fruit?
    a. Bailey, p. 147.
3. What is a pericarp?
    a. Bailey, p. 148.
4. What are dehiscent fruits?
    a. Bailey, p. 148.
    b. Coulter, p. 330.
5. What are indehiscent fruits?
    a. Bailey, p. 148.
    b. Coulter, p. 330.

6. What is an akene?
   a. Bailey, p. 148.
   b. Coulter, p. 327.
7. What is the capsule?
   a. Bailey, p.151.
   b. Coulter, p. 330.
8. What is the berry?
   a. Bailey, p. 152.
   b. Coulter, p. 332.
9. What is the drupe?
   a. Bailey, p. 153.
   b. Coulter, p. 332.
10. What is the pepo?
   a. Bailey, p. 155.
11. What is the pome?
   a. Bailey, p. 155.
   b. Coulter, p. 332.
12. What is the seed?
   a. Bailey, p. 5.
   b. Coulter, p. 64.
13. What is the embryo?
   a. Bailey, p. 164.
   b. Coulter, p. 65.
14. What is the caulicle?
   a. Bailey, p. 164.
15. What is the plumule?
   a. Bailey, p. 164.
   b. Coulter, p. 66.
16. What is the cotyledon?
   a. Bailey, p. 164.
   b. Coulter, p. 66.
17. What is the endosperm?
   a. Bailey, p. 164.
   b. Coulter, p. 66.
18. What is the seed-coat?
   a. Bailey, p. 164.
19. What is the micropyle?
   a. Bailey, p. 164.
   b. Coulter, p. 276.
20. What is the hilum?
   a. Bailey, p. 165.
   b. Coulter, p. 342.
21. What is germination?
   a. Bailey, p. 165.
   b. Coulter, p. 325.
22. What are the "mechanics" of germination?
   a. Coulter, p. 352.
   b. Bailey, p. 165, 166.
23. How does a bean germinate?
   a. Bailey, p. 167, 168.

24. How does a grain of corn germinate?
    a. Bailey, p. 168, 169.
25. What is the importance of seeds?
    a. Coulter, p. 336.
26. How are seeds protected?
    a. Coulter, p. 338.
27. How long will seeds live?
    a. Coulter, p. 339.
28. Why is the vitality of seeds important to the farmer?
    a. Coulter, p. 340.
29. What elements of food do seeds contain?
    a. Coulter, p. 343, 344, 345.
30. What are nitrogenous foods? 31. What are non-nitrogenous
    a. Coulter, p. 345. foods?a.Coulter, p.345.
32. What conditions necessary for germination?
    a. Coulter, p. 348.
33. What are the agencies of seed dispersal?
    a. Bailey, p. 158.
    b. Coulter, p. 353.
34. What are wind-travellers among seeds?
    a. Bailey, p. 159.
    b. Coulter, p. 354.

VIII - Growth of the Plant.

1. What is nutrition?
    a. Coulter, p. 40.
2. What is reproduction?
    a. Coulter, p. 40.
3. What is food?
    a. Coulter, p. 42.
4. What are the food materials a plant must have?
    a. Bailey, p. 72.
5. What are the mineral elements of plant food?
    a. Bailey, p. 72.
6. What is the source of the mineral elements of plant food?
    a. Bailey, p. 72.
7. What are the gaseous elements of plant food?
    a. Bailey, p. 72.
8. What two gases unite to form water?
9. Where does the plant get water?
    a. Bailey, p. 73.
10. Where does the plant get its carbon?
    a. Bailey, p. 74.
11. Where does the plant get its nitrogen?
    Answer- From the soil air in form of nitrates.
12. Where are these elements of food taken into the plant?
    a. Bailey, p. 72 (Section 152).
13. What is the difference between a rootlet and a root-hair?
    a. Bailey, p. 65 (Sec. 138).
14. What is Osmosis?
    a. Bailey, p. 66.
    b. Coulter, p. 104, 105.

15. What is osmotic action?
    a. Bailey, p. 67.
16. What is osmotic pressure?
    a. Coulter, p. 106.
17. What is the moisture in the root-hair?
    a. Coulter, p. 105.
18. What is the moisture outside of the root-hair?
    a. Coulter, p. 105.
    b. Bailey, p. 68 (Section 143).
19. In what direction do the molecules of a solution move?
    a. Coulter, p. 107.
20. What is it that permits the continued entrance of water into the roots?
    a. Coulter, p. 108.
21. What two things permit the solutes to continue entering the roots?
    a. Coulter, p. 109, 110.
22. What are the two kinds of movements in the plant body?
    a. Coulter, p. 111.
23. What is the effect of too much plant food?
    a. Bailey, p. 68, 69 (Sections 144, 145).
24. What is root pressure?
    a. Bailey, p. 69.
25. How does the soil hold moisture?
    a. Bailey, p. 70.
26. What do roots excrete?
    a. Bailey, p. 71.
27. How is the carbon taken into the plant?
    a. Bailey, p. 75.
28. How important is carbon?
    a. Coulter, p. 95.
29. How is carbon changed to starch?
    a. Bailey, p. 77 (Section 163).
    b. Coulter, p. 84, 228, 229.
30. What is the composition of starch?
    a. Bailey, p. 77.
31. What becomes of the starch manufactured in the leaves?
    a. Bailey, p. 78 (Section 166).
32. What is digestion?
    a. Coulter, p. 42, p. 350.
    b. Bailey, p. 79.
33. What is done with the digested food?
    a. Bailey, p. 79, 80.
34. What is assimilation?
    a. Coulter, p. 42, 351.
    b. Bailey, p. 80.
35. What is protoplasm?
    a. Coulter, p. 72, 73.
    b. Bailey, p. 80.
36. How is protoplasm made?
    a. Bailey, p. 80 (Section 171).
37. What is meant by "the working together of the whole machine"?

a. Coulter, p. 86, 87.

IX - Propagation of Plants.

1. What is the rhizome?
   a. Bailey, p. 16.
2. What is the underground stem?
   a. Coulter, p. 155.
3. What is one purpose of the rhizome?
   a. Bailey, p. 19.
4. What is the effect of cutting a rhizome into pieces?
   a. Bailey, p. 20.
5. How are plants propagated by roots?
   a. Bailey, p. 20.
6. How are plants propagated by layering?
   a. Bailey, p. 21.
7. What are creepers, runners and stolons?
   a. Bailey, p. 21.
8. How are plants propagated by means of leaves?
   a. Bailey, p. 22.
9. How are plants propagated by means of buds?
   a. Bailey, p. 22.
10. What is a graft?
    a. Bailey, p. 22.

X - Plant Environment.

1. What make up the environment of a plant?
   a. Bailey, p. 197.
2. What is the habitat of a plant?
   a. Bailey, p. 197.
3. Where do plants grow?
   a. Bailey, p. 197, 198, 199.
4. How do plants aid in the formation of soil?
   a. Bailey, p. 200.
5. What is acclimatization of plants?
   a. Bailey, p. 203.
6. How are plants influenced by the wind?
   a. Bailey, p. 204.
7. How are plants influenced by the soil?
   a. Bailey, p. 206.
8. What is the struggle for existence among plants?
   a. Bailey, p. 209, 210, 211, 212.
9. What is a plant society?
   a. Bailey, p. 219.
10. How may plants be made to vary?
    a. Bailey, p. 228, 229.
11. What are the causes of variation?
    a. Bailey, p. 230.
12. What is good agriculture?
    a. Bailey, p. 230.
13. What is plant breeding?
    a. Bailey, p. 231.
    b. Coulter, p. 446, 447, 448.

XI - Classification of Common Farm and Garden Plants.

1. Graminaceae - Grass family.
   corn, wheat, oats, rye, barley, sorghum, orchard grass, red top, timothy, blue grass.
2. Cruciferae - Mustard family.
   mustard, cabbage, cauliflower, collards, kale, Brussels sprouts, kohlrabi, radish, rutabaga, turnips, watercress.
3. Solonaceae - Nightshade family.
   potato, tomato, egg-plant, pepper.
4. Chenapodicaceae - Goosefoot family.
   beet, spinach, chard, mangel-wurzel.
5. Curcubitaceae - Gourd family.
   canteloupe, muskmelon, citron, cucumber, gourd, squash, pumpkin, watermelon.
6. Compositae - Thistle family.
   artichoke, chicory, dandelion, endive, lettuce, salsify, sunflower, tansy.
7. Liliaceae - Lily family.
   onion, garlic, leek, asparagus.
8. Leguminosae - Pea family.
   garden pea, Canada field pea, cowpea, soy bean, bush bean, Lima bean, velvet bean, vetch, clover, alfalfa
9. Umbelliferae - Parsley family.
   caraway, carrot, celery, parsley, parsnip, coriander
10. Rosaceae - Rose family.
    plum, cherries, almond, peach, apple, apricot, pear, quince, raspberry, blackberry, strawberry.

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THE SOIL.

(In connection with soil cultivation in the garden).

A-References for study.

1. Lyon and Fippin, The Principles of Soil Management.
   "The present book is the outgrowth of their experience in teaching soil technology through a period of several years. It has been their endeavor to present the applications of science to soil problems from the stanpoint of crop-production rather than that of any one of the underlying sciences of geology, chemistry, physics or bacteriology."Authors' Preface.

B - Outline Questions:

I - Rock and its Products.

1. From what is soil derived? p. 2, 3.
2. What elements of plant food are derived from the soil? p. 3.
3. What elements are derived directly or indirectly from air and water? p. 3.
4. What relation does soil sustain to plant growth? p. 1.
5. What are minerals? p. 4 (Bottom).
6. What are the two groups of minerals? p. 5.
7. What are the principal minerals of the earth's crust? p. 9 (Table).

8. What is rock? p. 9.
9. What is the arrangement of minerals in rock? p. 10.
10. What are igneous rocks? p. 11.
11. What are aqueous rocks? p. 11.
12. What are Aeolian rocks? p. 11.
13. What are metamorphic rocks? p. 11.
14. What are the most important of the igneous rocks? p. 12.
15. What are the most important of the aqueous rocks? p. 12.
16. What rocks are the most important agriculturally? p. 12(bottom)
17. Of what are they composed? p. 12, 13.
18. How is the air a factor in soil formation? p. 16.
19. How do heat and cold break down rocks? p. 18, 19.
20. What is the chemical action of water on rock? p. 21, 22.
21. What is the mechanical action of water? p. 24.
22. How has ice been an agency in making soil? p. 27.
23. How have plants and animals aided in soil building? p.28, 29.
24. What are sedentary soils? p. 31.
25. What are residual soils? p. 31.
26. What are cumulose soils? p. 31.
27. What agencies transport soils? p. 44 (bottom).
28. What are colluvial soils? p. 45
29. What are alluvial soils? p. 47.
30. What are glacial soils? p. 54, 55.
31. What are wind or aeolian soils? p. 60.
32. What is the difference between humid and arid soils? p. 64.

II - Physical Properties of Soil.

1. What is the difference between soil and subsoil? p. 68.
2. What is soil texture? p. 70.
3. What are the textural groups of soils? p. 73 (table middle page
4. What are the agricultural classes of soil based on texture? p. 74.
5. How can soil texture be modified? p. 87.
6. What is soil structure? p. 88.
7. What is plasticity of soils? p. 97.
8. Why does soil cement or "run together"? p. 99.
9. What are the four common cementing materials in soil? p.100, 101.
10. What are the two chief coloring materials in soil? p. 101.
11. What are the chief means of changing the structure of soils? p. 104.
12. What is the effect of changing the water content? p. 105.
13. What is the effect of freezing? p. 108.
14. What is the effect of tillage? p. 111.
15. What is the effect of the growth of plant roots? p. 113.
16. What is the effect of organic matter? p. 113.
17. What is the effect of soluble salts? p. 116.
18. What is the effect of animal life? p. 118.
19. What is the effect of rainfall? p. 119.
20. What is the source of organic matter in the soil? p.120, 121.
21. What chemical elements are added to the soil as the result of the decay of organic matter? p. 121, 122.
22. What are the physical effects of organic matter on the soil? p. 129, 130.

23. What are the chemical effects? p. 131.
24. What conditions favor the accumulation of organic matter in the soil? p. 132.
25. What conditions favor the rapid disappearance of humus from the soil? p. 132.

III - Water in the Soil.

1. In what three ways is water of service to plants? p. 133.
2. What three factors determine the amount of moisture a soil contains? p. 136.
3. What is gravitational water in soil? p. 141.
4. What is capillary or film water? p. 141.
5. What is hygroscopic water? p. 141.
6. What is the greatest determining factor in the water-holding capacity of soils? p. 144.
7. How does structure affect the moisture capacity of soils? p. 151.
8. Do you fully understand the difference between texture and structure as applied to soil?
9. How does organic matter affect soil capacity for water? p. 153.
10. What is the gravitational movement of water? p. 166.
11. What is capillary or film movement? p. 169.
12. How is the capillary capacity of soil measured? p. 175.
13. What is the thermal movement of water? p. 189.
14. What are the three ways of increasing the water content of soil? p. 191.
15. What is a mulch? p. 199.
16. How many kinds of mulches? p. 199.
17. What materials may be used as a mulch? p. 200.
18. What is a "dust mulch"? p. 203.
19. What is involved in the management of a mulch? p. 210.
20. What is the value of deep plowing? p. 218.
21. What factors affect the duty of water in irrigation? p. 224, 225.
22. What are the four principal methods of irrigation? p. 229.
23. What are the twelve most important effects of drainage? p. 239, 247
24. What are the two general types of drains? p. 248.

IV - Plant Nutrients in the Soil.

1. What substances are found in the ash of plants? p. 280.
2. What substances in the soil are absolutely essential to plants? p. 280.
3. What is the relation between root-hairs and soil particles? p. 287.
4. What are the causes of the difference in the absorbing power of plants? p. 292.
5. Upon what does the osmotic activity of a plant depend? p. 292.
6. What "feeding power" do cereal crops have? p. 294.
7. What "feeding power" do grasses have? p. 295.
8. What "feeding power" do leguminous crops have? p. 296.
9. What "feeding power" do root crops have? p. 296.
10. What "feeding power" do vegetables have? p. 296.
11. What "feeding power" do fruits have? p. 296.
12. What are alkali soils? p. 307.
13. What is the effect of alkali on crops? p. 312.
14. How reclaim alkali land? p. 315 (bottom).
15. What is a manure? p. 319.
16. In what three ways may manure make a soil more productive? p. 319.
17. What are the classes of manures? p. 322. (bottom.)

18. What are soil amendments? p. 348.
19. What effect does lime (calcium) have on tillage and bacterial action in soils? p. 348.
20. What effect does lime have on plant-food materials in the soil? p. 349.
21. What effect does lime have on toxic substances and plant diseases? p. 350.
22. What are the forms of calcium that may be applied to soils? p. 351.
23. What are the four factors affecting the efficiency of fertilizers? p. 356.
24. How is soil-moisture content a factor? p. 358.
25. What effect does the acid condition of the soil have? p. 359, 360.
26. How does organic matter assist? p. 361.
27. Of what importance is structure or tilth of the soil? p. 363.
28. What constitutes farm manures? p. 363-374.
29. What functions do farm manures perform in the soil? p. 384.
30. How do green manures benefit the soil? p. 384.
31. Why are leguminous crops valuable? p. 385.

V - Organisms in the Soil.

1. What is the value of the common earthworm? p. 389.
2. How do plant roots help to make the soil more productive? p. 391.
3. What are bacteria in the soil? p. 395.
4. What conditions affect the growth of bacteria? p. 399.
5. What effect do bacteria have upon the mineral matter of the soil? p. 403.
6. What effect do bacteria have upon nitrogenous organic matter in the soil? p. 407.
7. What are decay and putrefaction? p. 408.
8. What is ammonification? p. 410.
9. What is nitrification? p. 412.
10. What is dentrification? p. 420.
11. What is meant by nitrogen fixation? p. 423.

VI - Soil Air.

1. How does the texture of the soil affect the volume of air in the soil? p. 432.
2. How does the structure of soil affect the volume of air in the soil? p. 432.
3. What effect does organic matter have? p. 433.
4. What effect has moisture content? p. 433.
5. Why is oxygen necessary in the soil? p. 437.
6. What is the effect of carbon-dioxid in the soil? p. 438.
7. What effect does tillage have upon the soil air? p. 444.

VII - Heat of the Soil.

1. What three biological effects does heat in the soil have upon plant growth? p. 448.
2. What are the three sources of heat which reach the soil? p. 451.
3. Upon what does the temperature of the soil depend? p. 453.
4. What are the six means of modifying the soil temperature? p. 463.

VIII - External Factors in Soil Management.

1. What is tillage? p. 466.
2. What are the three objects of tillage? p. 467.

3. What are the tools of tillage? p. 469.
4. What are the objectional qualities of weeds? p. 490.
5. How control weeds? p. 490, 491.
6. What is crop-adaptation? p. 497.
7. What are the two determining factors in crop adaptation?p.499.
8. What are the physical requirements of plants? p. 499.
9. What are the chemical requirements of plants? p. 499.
10. What is the relation of rotation of crops to nutrients removed by different crops? p. 504.
11. What is the relation of rotation to root-systems? p. 505.
12. What is the relation of rotation to plant food preparation? p. 505.
13. How do crops differ in their effect upon soil structure? p.506.
14. How does rotation of crops affect plant diseases and insects? p. 508.
15. What is meant by "toxic" substances in soil? p. 509, 510.

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UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE

TEACHERS' COURSE 100 - ELEMENTS OF AGRICULTURE, NATURE STUDY AND SCHOOL GARDENS
O. J. KERN, ASST. PROFESSOR AGRICULTURAL EDUCATION.

PART III - The School Garden.

OUTLINES AND REFERENCES ON:-

September, 1918.

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PART II - The Home Garden and Vegetable Growing Project - - - June, 1918.

Part I - Elements of Agricultural Nature Study November, 1916.

THE SCHOOL GARDEN

"Train the children, each in its own little garden, to respect fruit trees, honorable profit, industry, beauty and good order; it is the summary of all Gospels to man." - News Letters of Thomas Carlyle.

I - Place of the School Garden in a Well-Organized Scheme of Agricultural Education.

1. A practical project in the art of agriculture.

   The school garden, whether a part of the school premises or outside ground controlled by the school may serve as a demonstration plot where boys and girls may be taught certain fundamental processes necessary to success in home garden work and productive agriculture in general. (See Part II, The Home Garden and Vegetable Growing Project.)

2. A laboratory or observation plot where boys and girls may learn the elementary facts in the four units of instruction in agriculture.
   a. Studies in plant life - garden crops, weeds, seeds.
   b. Studies in soils - characteristics and cultivation.
   c. Studies in animal life - insects, worms, birds, etc.
   d. Studies in management - planning, garden, rotation of crops, care of tools, harvesting, marketing. (See Part I, The Elements of Agricultural Nature Study.)

3. A means of teaching the elements of landscape art, the artistic arrangement of flowers, shrubs and trees, thus emphasizing the human or social values of agriculture.
   a. "Problems of parish or neighborhood economy, or rural beautification, are large enough to occupy the time and attention of several generations. The problems of rural roads, bridges, schoolhouses and grounds, church grounds, etc., are enough to occupy the spare time and attention of rural America for a hundred years to come. A neighborhood which becomes possessed with a common passion for beautification will never lack for social life." - Carver on Problems of Rural Social Life in Principles of Rural Economics.
   b. "The garden treatment ought to be the most common one, especially for bona-fide farms. This scheme is based upon the principle that every farm residence should have a small bit of lawn, a flower garden and a vegetable garden, and that all these ought to be artistically brought together as one organic unit focusing upon the farm house as the center." - Waugh in Rural Improvement.

4. Questions.
   a. Under what conditions will the teacher emphasize the productive or economic phase of the school garden?
   b. With what class of pupils may the teacher emphasize the second or informational values of the garden work?

c. In what communities and under what conditions may the teacher stress the aesthetic phase of the school garden?
d. May all three phases be emphasized in the same school?

II - Essentials of a Successful School Garden.
The primary needs for a school garden are the same as those for the home garden or for successful farming.

1. Leadership of a teacher who believes in garden work as an economic and educational project; who has enthusiasm and can impart some of that enthusiasm to boys and girls.
2. Sympathetic attitude of school authorities.
3. Personal equation of the pupil gardener.
4. A plot of ground with soil of suitable texture and fertility.
5. Seeds or plants or both.
6. Proper moisture to dissolve plant food in the soil so plant rootlets may make use of it.
7. Sunshine and warmth to bring about germination and plant growth.
8. Good cultivation and irrigation when necessary.
9. Tools.

III - Working Tools for the Garden.
A - Minimum equipment.

1. Spading fork, wide-tined. Useful for
   a. Digging up the soil.
   b. Breaking and pulverizing soil at time of digging.
   c. Spreading manure.
   d. Harvesting some crops.
2. The rake, steel, ten or twelve-toothed. Useful for
   a. Pulverizing soil.
   b. Killing weeds when very small.
   c. Breaking crust on surface soil after a rain or irrigation.
   d. Maintaining soil mulch for conservation of moisture.
3. The hoe, common one answers practically all purposes. Useful for
   a. Making drills or furrows in planting seeds.
   b. Mixing soil in hills.
   c. Cutting weeds.
   d. Cultivating soil when wheel hoe is not used.
4. The trowel, useful for
   a. Making drills for fine or small seeds.
   b. Transplanting cabbages, tomatoes, etc.
5. The Hand Weeder, useful for
   a. Loosening soil and destroying weeds between onions, carrots, beets and other small crops.
6. The Garden Line.
   a. Good, heavy cord that will reach the full length of the row.
7. Stakes.
   a. Pieces of board one by two inches, eighteen inches (minimum) in length, sharpened at one end.

8. Measures.
   a. Foot and half-foot measures marked off on a piece of wood (or a yard stick) for spacing rows.
9. The Watering Pot, two-gallon with medium fine spray, useful for
   a. Transplanting of plants.
   b. Germination of seeds.
   c. Spraying for pests.

B - Other useful tools.
1. Spade or shovel.
2. Wheel cultivator.
3. Wheelbarrow.
4. Hose for irrigation.
5. Small hand spray pump.

C - Management of Garden Tools.
1. How secure the necessary equipment?
2. What is the right way of using each tool in garden work?
3. How should the tools lie on the ground when not in use by the pupils?
4. What constitutes proper care of tools?
5. What is proper dress for children while engaged in gardening?
6. Who is responsible for the condition of the tool-house?
7. What is the relation of all this to good farm management?

D - References on Garden Tools:
1. Davis, "School and Home Gardening".
   a. Garden Tools and Implements, pp. 41-48.
2. Cobb, "Garden Steps".
   a. Tools, pp. 38-46.
3. Williams, "Gardens and Their Meaning".
   a. A Word for Good Tools, pp. 76-81.
4. Stebbins, "The Principles of Agriculture Through The Home and School Garden".
   a. Tools, pp. 44-48.
5. Greene, "Among School Gardens".
   a. Cost of Equipment, pp. 111-142.
6. French, "The Beginner's Garden Book".
   a. Garden Tools, pp. 239-247.

IV - Choosing The Garden Site.

A - On the school grounds.
1. Factors determining location of garden.
   a. Relation to playground.
   b. Proximity of buildings and trees.
   c. Character of soil.
   d. Exposure and drainage.

B - Off the School Grounds.
1. Factors determining location of garden.
   (1) City - a vacant lot.
   a. Absolute control by the School Board during garden period.
   b. Near as possible to the school building.
   c. Proper enclosure if civic ideals of trespass are low.

d. Exposure and drainage.
e. Character of soil.

(2) Country - adjacent farm land.
a. Absolute control by School Board during garden period.
b. Near as possible to the school building.
c. Proper fence as protection against poultry and other farm animals.
d. Exposure and drainage.
e. Character of soil.

C - Where no Choice of Sites is possible.
1. What unfavorable conditions may be modified or removed entirely?
2. How soon after school opens will you begin to solve the problem of the garden site?

D - After Garden Site is Determined.
1. Teacher and pupils in a general clean-up.
2. All rubbish, gravel, stones, brickbats, broken glass, raked into piles and carted away. The farther away the better.
3. Development of appreciation on the part of boys and girls in the clean garden plot, the clean school premises, the clean, orderly farm and home premises.
4. Discussion of soil improvement for the coming garden crops.

V - Improving the Soil of the School Garden.

A - References on Soil Improvement.

1. Wickson,"The California Vegetables in Garden and Field." (Fourth Edition).

No other book can take the place of this for California teachers with respect to California soil conditions. The references for these outlines are for the Fourth Edition. The references for Part II, The Home Garden and Vegetable Growing Project were for the Third Edition.

However, this should not cause any confusion as either adition may be used. To illustrate, suppose your query is: "How improve the adobe soils of California?" Look in the table of contents of either edition for the chapter most likely to have the information about soils. This is Chapter IV of both editions. Then turning through the pages of Chapter IV, adobe soils is treated on Page 45 of the Third Edition and on Page 36 of the Fourth Edition. The reading matter in both is identical.

2. Davis, "School and Home Gardening."
a. The Soil and Its Improvement, pp. 84-105.

3. French, The Beginner's Garden Book.
a. Preparing the Soil, pp. 248-262.

B - If garden soil is adobe, how improve?

1. Wickson (Fourth Edition), p. 36.

The entire reference is given here with analysis and practical application at close.

"Improvement of Adobe Soils - Our adobes, especially those of the darker hues, are rich and durable. In common with heavy clay soils everywhere they are retentive of moisture. In our arid summers, however, they lose their moisture speedily by evaporation, if untilled, and dry out to a greater depth than lighter soils. They are refractory under tillage and unless caught at just the right moment are either wax or rock under the plow, and the cultivator will either stick fast or ride over the surface. And yet if one has nothing but adobe he is not as badly off as he might be, because adobe is easily susceptible of improvement. The points to attain are several, but they are inter-related and effort for one measurably helps toward all.

The free use of burned lime, either as it comes from the kiln for builder's use or when air-slaked or water-slaked (hydrated), and applied about the time of the first rains is the first and simplest effort toward breaking up the tenacity of the soil. This should be done no matter what greater efforts are to be undertaken later.

Deep and thorough tillage, taking the soil at just that condition of moisture when it works well with plow and harrow, will be found to progressively improve its tillability by mere action of air and implements. If this is all that can be undertaken at first, do this thoroughly and put in the cultivator after each heavy rain as soon as the proper condition of soil arrives, so as to prevent baking of the surface. For winter growth of vegetables in regions of ample rainfall, use the ridge system, which will be described in a subsequent chapter.

But liming and persistent tillage are only temporizing with adobe and do not accomplish permanent reform. The first rational step is to resort to adequate drainage. Tile drains two and a half or three feet deep and twenty feet apart will do for garden plants. This leaves a clear surface for working over, but, if the expense of tiling is not desired, open ditches will answer, but they restrict cultivation in one direction, waste land, and are expensive in hard work in killing weeds in the ditches. Open ditches, are, however, better than no ditches at all. The effect of drainage is to promote friability, to render the soil tillable earlier and oftener, by the quick removal of surplus water, and to promote seed germination and plant growth.

The aeration of adobe by drainage and tillage accomplishes a considerable improvement, but still more

radical reform measures are desirable. The soil particles are naturally too small. They must be separated by interposition of coarser grains. Plow into the soil as much coarse material as possible. Farmyard manure, straw, sand, old plaster, coal ashes, sawdust, almost anything coarse or gritty which will break up the close adherence of the fine clay particles, release the surplus water and let in the air, will produce a marked effect in reducing the hateful baking and cracking, root-tearing and moisture-losing behavior of the adobe. Scrape the corrals, rake up the leaves and fine litter of all kinds, make the adobe garden patch the graveyard for all the rubbish which is susceptible of decay. The farm will be neater and the garden will pay the expense in its easier working and better growth. Do this every year before the rains come and you will rejoice that you had an adobe foundation for the farm garden."

2. Analysis of above quotation.
   a. First paragraph.
      (1) General characteristics of adobe soils.
      (2) Must be cultivated at the right time.
      (3) Ease of improvement.
   b. Second paragraph.
      (1) Use of lime - first remedy.
      (2) Time of application.
   c. Third paragraph.
      (1) Deep and thorough tillage - second remedy.
      (2) How often cultivate?
      (3) Ridge system for winter gardens.
   d. Fourth paragraph.
      (1) Drainage - kinds - third remedy.
      (2) Effect of drainage.
   e. Fifth paragraph.
      (1) Use of organic matter - fourth remedy.
      (2) Effect upon texture and structure.
3. Practical Application to Garden Plot.
   a. If possible, just before the rainy season begins, put on the garden site a plentiful supply of green barnyard manure.
   b. When sufficient rain has fallen turn this manure under by deep plowing.
   c. Apply lime after the plowing, harrowing it in to prevent wind blowing it away.

C - If garden soil is sandy, how improve?

1. Wickson (Fourth Edition) page 37.

"The Improvement of Light, Sandy Soils. - This effort is in some cases more difficult than conquering adobe. It all depends upon the coarseness of the sand and the subsoil upon which it rests. If the soil and subsoil are coarse sand or gravel to a considerable depth, some fruit trees may thrive, but

shallow rooting plants will fail unless they can finish their growth during the rainy season. Summer growth is impossible because water will flow through their sieve-like structure and carry away plant food with it. With moisture leaching away below and flying away above, and with intense sun heat burning the foliage by direct contact and reflection, such wash soils are indescribably worse than adobe. But this condemnation should not be rashly applied. The reference is to soils very coarse in character which have the appearance of washed sand and gravel. Otherwise it may be a soil carried from the surface of the hillsides by the eroding streams, and, if composed of reasonably fine materials, in addition to sand and gravel, should have plenty of plant food for a time at least. The chief difficulty will lie in maintaining moisture for shallow rooting plants. Obviously such soils are best suited for winter growth, for they are "warm and early" when situated out of frosty places.

Sandy soils which are imposed upon clay or hardpan, providing the underlying stratum is not alkaline, furnish very promising garden material even though the layer be too shallow for the growth of trees. Many fruit growers are struggling to maintain trees on such spots in their orchards when they should forsake the effort and by adequate use of water and manure turn such spots into family gardens. The holding of water near the surface, which is fatal to tree roots, is the opportunity for the growth of most vegetables. Depth of soil which is so strongly insisted upon in treatises on gardening, constitutes a storehouse of moisture and plant food, but it has been abundantly demonstrated that depth is not essential provided the plant is otherwise fed and watered. California gardens proceeding upon rainfall alone, need a deep, retentive soil; the irrigated garden may thrive upon a soil too coarse to be retentive providing it has a tight bottom to hold moisture within reach of shallow rooting plants. Therefore reclaim such sand by providing a home water supply, if not in an irrigated region, and use plenty of well-composted and decayed manure, which will not only feed the plants but also will reform its texture and transform the coarse sand into a rich garden soil, kind in cultivation and prodigious in its yields of succulent vegetables, for sand is best of all materials for free and rapid root development.

The treatment of such soil is directly opposite that prescribed for adobe. All coarse materials must go through composting, which will be described in

another chapter. The garden should be cleared of all its own coarse refuse and only fine compost or commercial fertilizers used upon it. Both of these act benignly upon its texture."

D - If garden soil is a good natural loam, how improve?
1. Good cultivation and use of organic matter.

VI - Planning the Garden.
A - Cooperative work of pupils and teacher.
1. Indoor work during winter in preparation for spring planting.
2. Selection of crops to be grown. Study of seed catalogues.
3. Factors determining selection of vegetables to be grown.
4. Study of cultural methods of crops selected. Use of reference literature.
5. Making a planting calender suited to the locality. Seed catalogues for suggestions. Consult a good local gardener.
6. Purchase of seeds.
7. Testing of seeds.
a. Germination for vitality.
b. Inspection for purity as to dirt, weed seeds, or other foreign material.
c. Selection of best seeds of a particular lot for planting by themselves.
d. Care of seeds until planting time.
8. Measurement of the garden plot and reproduction on paper to a scale. Each pupil have a copy.
9. Location of rows of vegetables on paper.
a. Serves as a guide in planting.
b. Valuable as a record in planning next year's rotation of crops on the same plot of ground. Emphasize importance of this.
10. Opportunities for succession of crops in a single season.
11. Possibility of companion cropping in a single season.
12. Protection for garden, if needed. Tools ready and a place to keep them.

A - Administrative Problems to be decided by the teacher without consulting pupils.
1. Shall I use the old individual plot system?
a. Advantages and disadvantages.
b. Size and form of individual plots.
2. Shall I use the dual plot system - two pupils assigned to a single plot?
a. Advantages and disadvantages.
3. Shall I use the community garden system?
a. No divisions, the garden planted as one big area, each variety of vegetables in rows by itself, all pupils having a common interest in a common enterprise, with processes being taught valuable for home garden work. Community ownership of products.
b. Advantages and disadvantages.
4. Shall I use the long row system?

a. Rows running the longest way of the garden with individual assignment of space, each pupil having ground enough for three or four rows (if possible) with possibility of two or three varieties of vegetables growing in a single row. Individual ownership of products.
b. Advantages and disadvantages.

5. Shall I use a combination of the community and the long row systems?
a. Individual assignments of long rows with a strip of ground full length of garden for community cooperative work for certain crops as perennials and large crops as pumpkins, cucumbers, sweet corn, etc.
b. Advantages and disadvantages.

6. Factors in helping the teacher to make a decision.
a. Economy of space.
b. Cultivation of growing crop.
c. Ease or difficulty of irrigation.
d. Management of children, the group or the individual.

C - Pedagogical Problems for the Teacher.
a. Place of garden activity in the daily program.
b. Correlation of garden studies with the regular work of the school.

D - Reference Literature on Planning the School Garden:
1. Davis,"School and Home Gardening."
a. Planning the Garden, pp. 27-40.
2. Cobb,"Garden Steps."
a. Garden Plans, pp. 7-18.
3. Meier, "School and Home Gardens".
a. Plan of the School Garden, pp. 235-242.
4. Stebbins, "The Principles of Agriculture through the School and Home Garden."
a. The Garden, pp. 37-54.
5. Greene, "Among School Gardens."
a. Different Kinds of School Gardens, pp. 41-80.
6. Williams, "Gardens and Their Meaning ".
a. Plotting and Planning, pp. 61-75.
7. French,"The Beginner's Garden Book."
a. Planning the Garden, pp. 176-192.

VII - Preparation of the Seed Bed.
1. Right condition of soil for working.
2. Tillage of preparation and its character.
a. In the fall for the spring garden.
b. In the spring for the spring garden.
c. For the winter garden.

3. References on tillage of preparation:
(1) Wickson,"The California Vegetables in Garden and Field" (Fourth Edition).
a. Tillage to receive moisture, pp. 67-68.
b. Tillage to conserve moisture, pp. 68-70.
c. Cultivation in small gardens, pp. 71-72.
(2) Cobb, "Garden Steps".
a. Fall and Winter Preparations, pp. 1-6.

(3) Stebbins, "The Principles of Agriculture Through the School and Home Garden."
a. Some characteristics of an Ideal Seed Bed, pp.27-30.
(4) Davis,"School and Home Gardening".
a. The Soil and Its Improvement, pp. 84-105.
(5) Greene, "Among School Gardens".
a. Soil Fertility, pp. 82-108.
(6) French, "The Beginner's Garden Book".
a. Spading, raking, etc., pp. 257-259.

VIII - Planting the Seed.

1. Distance apart of rows.
a. Factors determining.
2. Depth of planting.
a. Conditions regulating.
3. Guide for planting and thinning.

The following is adapted from seed catalogue of Morse & Company, San Francisco. Consult seed catalogues for local variations.

Variety of Vegetables	Quantity of seed 100 ft. row	Depth of Planting	Rows apart	Plants apart in row
Beans	1 lb.	1 - 2 in.	18 to 24 inches	3 to 4 inches
Beets	2 oz.	1 - 2 in.	12 " 18 "	2 to 4 inches
Cabbage	¼ oz.	½ in.	24 " 30 "	12 " 18 inches
Carrot	1 oz.	½ - 1 in.	12 " 18 inches	2 inches.
Corn	1½ lbs. 100 hills	1 - 2 in.	36 inches	24 to 30 inches
Cucumbers	½ oz.	1 - 2 in.	4 to 6 feet	4 ft. hills
Kohlrabi	¼ "	½ inch	18 inches	4 to 6 inches
Lettuce	½ oz.	½ inch	15 to 18 inches	4 to 6 inches
Onion	½ oz.	1 inch	12 to 14 inches	4 inches
Peas	2 lbs.	2 - 4 in.	14 to 36 inches	2 inches
Radish	1 oz.	1 inch	12 to 18 inches	1 to 2 inches
Spinach	1 oz.	1 inch	12 to 18 inches	3 to 4 inches
Tomato	¼ oz.	½ inch	4 to 6 feet	3 to 6 feet
Turnip	½ oz.	½ inch	10 to 18 inches	3 to 8 inches

4. Making the seed furrow.
5. Scattering seed in the furrow.
6. Covering the seed.
a. Wickson, p. 108.
7. Soil firming.
a. Wickson, p. 108.
8. Soil opening.
a. Wickson, p. 109.
9. Mulching.
a. Wickson, p. 109.
10. Irrigation for seed germination.
a. Wickson, p. 109.
11. Thinning of plants.

IX - Growing Plants Indoors and Transplanting.
1. What plants may be grown indoors?
2. What are the advantages?
   a. Economy.
   b. Danger of introducing diseases.
   c. Choice of select varieties.
   d. Plants ready when needed.
   e. Pleasure in growing plants from seed.
3. A suitable box or flat for growing plants.
4. Planting and care of the flat.
5. Guiding principles in transplanting.

A - References.
1. Part II (this Course) The Home Garden and Vegetable Growing Project.
   a. Growing plants for the garden, p. 7.
   b. Transplanting, p. 8.
2. Davis, "School and Home Gardening".
   a. Hotbeds and Coldframes, pp. 49-57.
3. French,"The Beginner's Garden Book".
   a. Transplanting, pp. 277-283.

X - Cultivation and Irrigation.
1. Tillage of maintenance.
2. Tillage to conserve moisture.
   a. Wickson, p. 68.
3. Importance of the earth mulch.
   a. Wickson, p. 69.
4. Importance of thorough tillage.
   a. Wickson, pp. 71-72.
5. Best means of irrigation.
6. Flat culture.
   a. Wickson, p. 74.
7. Ridge and raised bed culture.
   a. Wickson, pp. 73-74.

A - References:
1. French, "The Beginner's Garden Book".
   a. The Seedlings, Outdoors, pp. 269-276.
2. Davis, "School and Home Gardening".
   a. Irrigation and Drainage, pp. 106-112.
3. Stebbins,"The Principles of Agriculture Through the School and Home Garden".
   a. Care of Seedlings, pp. 71-80.

XI - The Garden and Vacation.
1. Why is it important that the garden be well cared for during vacation?
2. Who is responsible?
3. Possible cooperation.
   a. Committee of pupils and teacher.
   b. Committee of pupils and member of Parent-Teacher's Association.
   c. Committee of pupils and the janitor.
   d. All garden pupils and paid supervisor selected by the

Board of Education.
e. Select committee of pupils alone.
4. Provisions for Harvesting the Crop.
5. Arrangements for the School Fair.
a. Exhibit of school garden products.
b. Exhibit of school-home garden products.

XII - The Garden and the Regular Work of the School.
1. Correlation with arithmetic.
2. " " language.
3. " " reading and literature.
4. " " drawing.
5. References:
(1) Davis, "School and Home Gardening".
a. Correlation with other school work, pp. 322-334.
(2) Williams, "Gardens and Their Meaning".
a. New Life in Old Subjects, pp. 159-178.
(3) Greene, "Among School Gardens".
a. An Outline in Garden Study, Note 11, opposite p. 294.

XIII - Studies in Vegetable Characteristics and Cultural Requirements.
1. Reference material for study.
a. See outlines and references on Vegetable Growing Project in Part II, this course.
2. Supplementary Outlines and References.
A. General outline for the garden vegetable.
(1) Brief history.
(2) Why so long and generally grown.
(3) Food value.
(4) Cultural requirements.
a. Soil best adapted.
b. Soil preparation.
c. Distance of rows.
d. Depth of planting.
e. Thinning of plants.
f. General cultivation.
g. Fertilizing.
h. Harvesting.
i. Marketing.
j. Storage.
k. Diseases.
l. Pests.
(5) Home problems.
a. Improvement - selection.
B - References for Individual Vegetable Study.
1. French, "How to Grow Vegetables".
a. By the same author as "The Beginner's Garden Book" referred to above. Description of individual vegetables, pp. 1-299.
2. Meier, "School and Home Gardens".
a. Description of individual vegetables, pp. 244-307.
3. Davis, "School and Home Gardening".
a. Description of individual vegetables, pp. 176-207.

4. Bailey, "The Principles of Vegetable Gardening".
   a. Description of individual vegetables, pp. 271-450.
5. Wickson, "The California Vegetables in Garden and Field".
   a. Description of individual vegetables.
      (a) Fourth Edition, pp. 120-275.
      (b) Third Edition, pp. 139-296.
6. Cobb, "Garden Steps".
   a. Description of individual vegetables pp. 47-215.

XIV - Plant Studies in Connection with the Garden.

A - Plant Studies.

1. Parts of a plant.
2. Kinds of roots.
3. Use of the root to the plant.
4. How the root does its work.
5. Soil conditions necessary for good root growth.
6. The stem and its work.
7. Leaves and their uses.
8. The flower - parts - pollination and fertilization.
9. Fruit - seed - parts of the seed.

B - References on Plant Study.

1. French,"The Beginner's Garden Book".
   a. The purpose of a plant, pp. 1-7.
   b. A seed and its growth, pp. 49-56.
   c. The testing of seed, pp. 57-64.
   d. The life of a plant, pp. 65-72.
2. Meier, "School and Home Gardens".
   a. Germination of seeds, pp. 211-223.
3. Stebbins, "The Principles of Agriculture Through The School and Home Garden."
   a. The seed and its needs, pp. 16-26.
   b. Roots, pp. 148-158.
   c. Stems and leaves, pp. 159-171.
   d. The flower, pp. 172-182.
4. Davis, "School and Home Gardening".
   a. Plants in relation to soil, light and air, pp. 58-65.
5. Bailey,"Botany - An Elementary Text for Schools".
   a. The root, pp. 7-13.
   b. The stem, pp. 14-18.
   c. How the plant takes in soil water, pp. 64-73.
   d. The making of living matter, pp. 74-84.
   e. Parts of the flower, pp. 122-127.
   f. Fertilization and pollination, pp. 128-135.
   g. Dispersal of seeds, pp. 158-163.
   h. Germination, pp. 164-171.
   i. Variation and its results, pp. 228-232.

XV - Soil Studies.

A - Brief Outline on Soil.

1. What soil is.
2. Agencies in the formation of soil.
3. General classification of soils.
4. Leading types of farm and Garden Soils.
5. Humus in soil.
6. Soil Fertility.
7. Soil Organisms.
8. Soil Water.
9. Soil Temperature.
10. Air in the Soil.
11. Cultivation of Soil.
12. Soil and Crop Rotation.

B - Reference Literature on Soil.

1. Davis, "School and Home Gardening".
   a. The soil and its improvement, pp. 84-105.
2. Cobb, "Garden Steps".
   a. Fertilizers, pp. 19-29.
3. Stebbins, "The Principles of Agriculture Through the School and the Home Garden."
   a. The Soil, pp. 1-6.
   b. Water and Soil, pp. 7-15.
   c. Improvement of Soil, pp. 183-189.
   d. The Origin of Soil, pp. 239-245.
4. French, The Beginner's Garden Book.
   a. The Soil, pp. 82-87.
   b. The Soil Water, pp. 88-96.
   c. Plant Chemistry, pp. 97-103.
   d. Humus, pp. 104-108.
5. Lyon and Fippin, "The Principles of Soil Management".
   (1) External factors in plant growth, p. 1.
   (2) Elements essential to plant growth, p. 3.
   (3) Important soil-forming minerals, p. 4.
   (4) Abundance of common minerals, p. 8.
   (5) Definition of rock, p. 9.
   (6) Causes of rock-decay, p. 14.
   (7) Meaning of soil texture, p. 70.
   (8) Classification of soils based on texture, p. 73.
      a. Fine Gravel.
      b. Coarse sand.
      c. Medium sand.
      d. Fine sand.
      e. Very fine sand.
      f. Silt.
      g. Clay.
   (9) Agricultural classes of soil based on texture, p. 77.
      a. Coarse sand.
      b. Medium sand.
      c. Fine sand.
      d. Sandy loam.
      e. Fine sandy loam.
      f. Loam.

f. Loam.
g. Silt loam.
h. Clay loam.
i. Sandy clay.
j. Silt clay.
k. Clay.

(10) Changing soil texture, p. 87.
(11) Meaning of soil structure, p. 88.
(12) Ways of changing soil structure, p. 104.
(13) Sources of organic matter in the soil, p. 120.
(14) Physical and chemical effects of organic matter, pp. 129-131.
(15) The three forms of water in the soil, p. 141.
(16) Means of increasing the water content of soil, p. 191.
(17) Kinds of mulches, pp. 199-200.
(18) Effects of drainage, p. 239.
(19) Relation between root-hairs and soil-particles, p. 287.
(20) Growing vegetables, p. 296.
(21) Reclamation of alkali land, pp. 314-316.
(22) Effect of lime as a soil amendment, p. 348.
(23) Bacteria in the soil p. 395.
(24) Functions of the soil air, p. 437.
(25) Biological function of soil heat in relation to plant growth, p. 448.
(26) Ways of changing soil temperature, p. 463.
(27) Objects of tillage, p. 467.
(28) Factors in crop-adaptation, p. 499.
(29) Principles underlying crop-rotation, pp. 504-511.

XVI - Studies in Animal Life.
A - Enemies of the garden.
1. Animals gopher, mole, rabbit.
2. Birds - sparrows.
3. Insects.
a. Chewing, characteristics of most common ones.
b. Sucking, characteristics of most common ones.
4. Study of an insect.
5. Life history of an insect or animal harmful to the garden.
6. Methods of controlling injurious insects.
B. Friends of the garden.
1. Life history of a beneficial insect or animal.
C. Sprays for insect pests and plant diseases.
1. Formulas.
2. Methods of application.
D - Reference literature.
1. Part II, The Home Garden and Vegetable Growing Project.
a. Garden diseases and insect enemies, pp. 9-10.
2. Davis, "School and Home Gardening".
a. Insects, Diseases and Their Control, pp. 276-292.
3. French,"The Beginner's Garden Book".
a. Plant enemies, pp. 284-290.
b. Plant friends, pp. 291-295.
4. Stebbins, "The Principles of Agriculture Through the School and Home Garden".

a. Weeds, pp. 191-199.
b. Insects, pp. 201-207.
c. Birds, pp. 208-218.
d. Plant Diseases, pp. 219-225.

XVII - The School Garden and Landscape Art.

1. Educational influence of environment.
2. Good landscape and art.
   a. "The natural landscape is always interesting and it is satisfying. The physical universe is the source of art. We know no other form and color than that which we see in nature or derive from it. If art is true to its theme, it is one expression of morals. If it is a moral obligation to express the art-sense in painting and sculpture and literature and music, so is it an equal obligation to express it in good landscape." Bailey, (The keeping of the beautiful earth) in "The Holy Earth".
3. Civic Art and Community Ownership and Responsibility.
   a. "It would lead us too far afield from our present studies should we attempt here to elucidate all the basic principles of landscape architecture and to apply them to the subject in hand. We may only say here that the great principles or order, which are the principles of design, rule supreme. To have everything done in perfect order - to have everything kept in perfect order - this is the keynote of Civic art.

      "Civic art strives to secure this perfect good order - this maximum of utility plus a maximum of beauty - in the things which belong to the community. These public possessions are streets, commons, parks, playgrounds, school buildings, churches, libraries, town halls, court houses, and scenery, with various other important items. Unfortunately the sense, and even the knowledge, of common public ownership in such things is still very weak in America. For too many years we have laid every stress on the private ownership of our own individual property. All laws have been made to protect individuals in this personal right. All preaching has aimed to quicken conscience with reference to the rights of others. And so we have almost forgotten that most of the greatest gifts in the world belong to nobody - that is to everybody - that is, to us all." Waugh, "Rural Improvement".

4. School grounds belong to entire community.
5. Develop sense of common responsibility.
6. Need of civic awakening.
7. A planting plan.
8. The A B C of planting along natural lines.
   A - Leave open spaces.
   B - Plant in masses.
   C - Curved line effect.
9. Not necessary to sacrifice the playgrounds to have attractive school grounds.
10. The District School Improvement Society.
    a. Cooperation of school and home.
    b. Leadership of the school.
11. One way of observing Arbor Day.
    a. Program of recitations, songs about the brave old tree followed by a half-holiday.
12. Another way of observing the Arbor Day Spirit.
    a. Entire community meet on the school grounds for work with shovels, spades, rakes, hoes, etc. Picnic lunch and program of entertainment after program of work completed.
13. Illustrations of School Grounds Improvement.
    a. "Set out twelve trees, eight wild grape vines, a clematis, a Boston ivy, outhouses screened and yard raked."
    b. "New fence, six trees and four grape vines set out."
    c. "Planted three Ash, three Elm and seven Box Elder Trees. Set Boston Ivy along school building, and woodbine along back fence and closets. Also planted eleven Spirea Van Houttei, two Weigelia and eight Lilacs."
    d. "Many shrubs set out: forty Sumac, ten Elderberry, two Cedars, two Mulberry, a Syringa, an Hydrangea, and an Elm tree."
    e. "Yard raked, new cement steps and curbing."
    f. "A dozen Boston Ivy set around stone school building, wire screens around out-buildings with wild cucumber vines, two lilacs, two rose bushes and three Cedar trees planted."
    g. "Cleaned the yard and burned the rubbish."
    h. "Bed of asters, phlox and nasturtiums. Planted ornamental gourds and climbing nasturtiums near the fence, and morning glories at two of the windows."
    i. "Made two flower beds and planted sunflowers, hollyhocks and climbing beans."
14. The right way of transplanting trees and shrubs.
15. Care after planting. Value of the straw mulch.
16. Effect upon the home.
    a. "Our first care must be the creation of real country homes. Here we shall have the primal

art of nature to assist us, with its latest interpretations by science. It is a new thought of high art that is growing among the people that instead of buying pictures to hang on our walls, we may better create them on the sod, with living plants and running brooks.....

"Man who spoils is the same man who can create and improve. We have a century behind us of mutilation; we must have a century ahead of sympathy and cooperation with nature. This must involve not only work on the part of our government, but on the part of individuals. We must learn the great truth that man can cultivate the beautiful and make money at it. The economics of the country home take in the flowers and trees, as well as the beets and the turnips." - Powell, "The Country Home"

XVIII - Some Planting Material.

The following list of trees, shrubs and vines was prepared by Miss Katharine D. Jones of the Division of Landscape Gardening and Floriculture, College of Agriculture, University of California. It is necessarily brief, and includes the material that is hardy and usable practically over the entire state:

1. Seven Goods Trees.

a. Big-Leaf Maple (Acer macrophyllum)

A native tree which grows quickly if given care and water. It loves best deep, moist soil and will give abundant shade from the hot sun.

Propagated by seeds sown as soon as ripe.

b. Canary Pine (Pinus canariensis)

No other pine seems to thrive so well throughout the state as this species. It is handsome, long-lived, clean, groups well with almost any other tree and seems to fit our landscape. While it is not in reality so handsome as our native Monterey, the latter is too short-lived to warrant a general use throughout the state.

Propagated by seeds, which may be slightly filed to admit water.

c. Deodar Cedar (Cedrus deodara)

This beautiful tree thrives in all parts of California and can not be too widely planted. It is very trim and formal looking in youth and pleases by its symmetry, while in age its majestic size and beauty adds to any school that has ample grounds for it. The lower branches should never be pruned but be allowed to sweep the ground. It is sometimes used as an avenue tree, especially in So. California, but in that case should have ample space to grow its lower branches.

It is propagated by seeds.

d. Incense Cedar (Librocedrus decurrens)

This native tree is quite rapid in growth and as it is easily transplanted it can be removed from the wild and set in the school yard. It will thrive in most soils if given good drainage and makes a most beautiful specimen with its evergreen fragrant leaves.

Propagated by seeds.

e. Lawson Cypress (Chamaecyparis lawsoniana).

This is another of our native trees which is very ornamental and should be included in our school grounds. There are many horticultural forms from each of which we may select something for varying use. Some are dwarf, others extremely slow, hence adapted to tub planting, and still others pyramidal and adapted to formal gardens.

It is propagated by seed, and the rare varieties by graftage.

f. Magnolia (Magnolia grandiflora)

This tree is very attractive with its glossy green leaves and its fragrant flowers which are followed by red fruits in the warmer regions of the state. It is rather dirty on a lawn as it continually drops its leaves, but on unkept portions of the grounds this is no objection. It groups well with the English laurel (Prunus laurocerasus) and trees with that type of leaf.

Propagated by seeds or layerage.

g. Oriental Sycamore (Platanus orientalis)

This is a quick-growing, deciduous shade tree that loves a deep, moist soil and should therefore have an abundant supply of water to make its best growth. It is especially appropriate for school grounds since it was under the shade of the Oriental Sycamores that Greek philosophers used to gather to study and teach.

Propagated by seeds or by hard wood cuttings in fall.

2. Twelve Good Shrubs.

a. Christmas Berry (Photinia arbutifolia)

One of our most attractive native shrubs on account of its dark evergreen foliage and its bright red berries. It groups well with Coast Live Oak, Catalina Cherry and Mahonia, since all are drought resistant and the leaves have the same shape and texture. Set the Christmas Berry next to the oak and the Mahonia as the facer shrub.

Not only does the Christmas Berry group well in mass planting, but the flowers bloom in July when most needed, and the berries are at their

best from late fall until Christmas when they give an attractive color note to the landscape.

Propagated from seed.

b. Common Myrtle (Myrtus communis)

This is a neat, free blooming, small leaved species that may be used for various purposes, such as for pot plants, for hedges and for shrubbery masses. It requires some watering, hence would do well near a lawn or in some situation where it would receive care. It groups well with Abelia grandiflora and with the small-leaved Myrtle (Myrtus communis microphylla). Its flowers are white and very free flowering.

It may be propagated either from seeds or from cuttings.

c. Cotoneaster pannosa.

Use this where a grey foliage berried plant is desired. As it is rather erect and stiff it should be placed behind a facer shrub. Its berries are a good red and remain on the bush for a long period.

Propagated by seeds or cuttings.

d. Euonymus japonicus.

Desirable for its foliage effect alone, except in such localities as permit its fruit to develop, when it is used for its gorgeous red and orange berries. Its leaves are smooth and shining and therefore shed dust better than those with a rough surface. It is generally used as a filler shrub to tie together other shrubs of similar habit, leaf shape and texture. It has many variegated forms, much beloved by nurserymen, but these should be used with caution since they are accent shrubs to be set only here and there to give a bright touch to an otherwise monotonous planting.

Propagated by cuttings in the fall or in the spring.

e. Italian Yellow Jasmine (Jasminum humile)

An evergreen, everflowering shrub that grows readily from cuttings and for that reason should be easily available for plant propagation work. It will grow either in sun or shade, is fast growing and should be used as a background in mass planting.

f. Japanese Quince (Chaenomeles japonica)

This hardy plant is deciduous and blooms before the leaves appear. It should therefore be placed against a green background of foliage to bring out the color. It may be obtained in pink, white or red and perhaps a salmon color.

Propagated by hard wood cuttings in the fall.

g. Mahonia aquifolium (Syn. Berberis aquifolium)

This is attractive both in fruit and flower; and will grow either in sun or in shade. Aaron's Beard (Hypericum calycinum) used as a ground cover underneath it at Capitol Grounds, Sacramento, looked extremely well. It also groups well with Islay (Prunus ilicifolia) and with Berberis darwinii and Daphne.

Propagated by seeds.

h. Pittosporum tobira.

This is useful where a slow growing species is required and may be used either in sun or shade. It, together with its variegated form, is much used in the interior valleys where it thrives wonderfully well and makes a good group with Euonymus japonicus or with Laurustinus (Viburnus tinus). The flowers are white, aging yellowish, and are very fragrant.

Propagated by seed.

i. Pyracantha crenulata.

Every school ground should have some berried plants and they will grow readily either from seeds or cuttings. They may be kept low or be allowed to grow tall, and if given plenty of water during the fruiting season, they will reward you with a brilliant coloring of fruit. Berried plants should be set in an inconspicuous place but against a background of good green that will act as a foil for the fruit when ripe.

Or if you desire an orange colored fruit, you should select P. coccinea lalandii, which is even a greater favorite than P. crenulata, since its foliage is more abundant.

j. Tamarix parviflora.

This blooms early in the spring and has an airy effect. Since it is deciduous it should be placed in an inconspicuous place in the background where it will not be noticed until it bursts into bloom in the spring. It grows readily from hard wood cuttings in fall or soft wood in spring, and should be in every school yard where plant propagation is taught.

(a) Two shrubs for Hedges.

(1) Privet (Ligustrum)

For hedge plants perhaps you cannot do better than to try Privet, securing from your local nurseryman the species that does best in your locality. About the Bay Region they favor L. sinense or L. ovalifolium; Santa Barbara boasts of several varieties which are well adapted; So. California selects a type which they have named L. reevesiana from Mr. Reeves who propagated and distributed it. It is small leaved and does not burn in the hot sun as do some of the other types.

Propagated by cuttings.

(2) Atriplex breweri.

This is a quick growing shrub which has some favor as a hedge plant since it is easily clipped and readily replaced if injured. It is in keeping with the brown summer aspect of our landscape in the country but its gray foliage is not in harmony with most cultivated plants in the garden. It is resistant to alkali and drought but will not stand much frost, hence will be largely restricted to Southern California and to the coast region.

Propagated readily by cuttings.

3. Eight Good Vines.

a. Akebia quinata.

A quick growing climber which is ordinarily evergreen here but drops its leaves for a short time in regions of heavy frosts. It is much admired in the eastern states and can be variously used in California either for fence, lath house, pergola, summer house or as a porch screen. It is hardy and will grow either in the sun or the shade. The flowers are maroon and rather inconspicuous but the chief vlaue of the plant lies in its foliage which conceals or drapes and yet does not form too heavy a mass.

Propagated by seeds or cuttings.

b. Boston Ivy (Parthenocissus tricuspidata) (Syn. Ampelopsis)

A deciduous, rapid growing vine which climbs by means of tendrils with adhesive tips and is very satisfactory throughout the state. It is decidedly popular because it colors up well in the fall and also because it needs no support. It readily climbs walls of brick, stone, cement or wood and forms a clean, handsome covering that intensifies the architectural lines of a house without concealing them.

Virginia Creeper (P. quinquifolia) may also be used for the same purposes as Boston Ivy, but seems more suited to low fences or to climbing tall trees since it forms festoons and does not injure the bark of trees by climbing too closely to it as does Boston Ivy.

Both are propagated by cuttings.

c. Bignonia unguis-cati (Syn. B. tweediana)

This plant is not adapted to every use but can not be excelled where a delicate tracery is desired on a cement or stone house. Keep the plant thinned so that it will send out a new growth. It is adapted to tall houses since it loves to climb high, but it has the fault of dropping its lower leaves which condemns it as a screen.

Propagate by cuttings.

d. Evergreen Trumpet Creeper (Phaedranthus buccinatorius)
(Syn. Bignonia chevere)

This climbs by means of its flat, disk-like tendrils and is especially desirable where you wish a tall, fast-growing vine which does not have to be supported. It attains a height of 35 feet, a width fully as great, and is free blooming for many months in the year. The foliage is a dark green which is a good foil for the red flowers.

There seem to be two forms of this species, one with smaller leaves, further apart which grows readily from root cuttings and a larger leaved, larger flowered form which is a much better looking plant but more expensive, since it is very difficult to root from cuttings and must be layered. One sells for 25¢ and the other for $1.50. It is better to buy the higher priced one since it is well worth the difference in the long run.

Since this species is tender it would be well in the hot interior valleys to substitute for it the Chinese Trumpet Creeper (Campsis chinensis, Synonym Tecoma grandiflora). In such regions it is much used to climb trees or to screen porches since a deciduous vine is needed to protect from the hot sun in summer and to let in the warm sunshine in winter.

e. Jessamine; Common Jasmine (Jasminum officinale)

This is particularly good as a screen vine about school buildings. It is neat, fragrant, almost everblooming and softens harsh lines as well as covers up unsightliness. It is equally good on fence, pergola, summer house or as a porch screen.

Propagate by cuttings of ripe wood in fall.

f. Hall's Honeysuckle (Lonicera japonica var. Halliana)

This is good for general utilitarian purposes, since it covers well, makes a thorough screen and is rapid growing. For school purposes it is equally satisfactory for house, porch, out-buildings or embankments. For screen purposes it may be grown against a chicken wire support or against a board fence or building. For the latter use it must be held in place by means of straps. It will grow to a height of 30 feet but by clipping may be kept as low as desired. It is hardy and evergreen except in regions of severe frost when it is apt to lose its foliage for a short time. It should be pruned occasionally, at least every two or three years, to prevent the accumulation of too much dead wood and dirt, and also to produce an abundance of flowers which bloom on the new wood. The flowers are white, turning to buff with age. The foliage is a light green. If for any reason a darker green foliage is desired, you should use Lonicera japonica chinensis which may be recognized by the purple color of the under sides of leaves and especially by the purple veins; also by the flowers being tinged with red

on the outside. Both are well distributed throughout the state, and in fact, are often interchanged unknowingly by nurserymen.

Propagate by cuttings.

g. Passion Flower (Pasdiflora caerulea)

This is a very satisfactory vine where a quick growing screen is desired since it covers completely without becoming too rampant, as do many of the other passion vines. It is pleasing both in foliage and in its blue tinged flowers, though if another color is desired the white form, Constantine Elliott, may be used.

It is hardy and may be propagated either by seeds or by cuttings.

According to legend, this is the plant found in S. America by the Spaniards and called the Passion Flower since "they saw in its several parts the emblems of the passion of our Lord", the styles representing nails, the corona the cross of thorns and some reddish blotches under the corona, drops of blood. Not only had the flowers been peculiarly marked in this manner but the leaves also had round spots underneath which they interpreted to mean money,---the thirty pieces of silver.

h. Potato Vine (Solanum jasminoides)

A rapid growing vine, especially in Southern California where specimens at the San Diego Exposition grew 30 feet in two years. It does not usually screen heavily, hence use where you wish only partially to hide or to adorn. It grows in this state from north to south, but the foliage is apt to turn red in winter during heavy frosts. The flowers are everblooming, and bluish in color, but there is also a white-flowered form which is even more attractive than the type since its foliage is more abundant. Do not use on chicken wire expecting to screen out-houses since it is usually leafless for several feet above the ground and does not conceal.

Propagate by cuttings.

It is hardly neeessary to emphasize the need of a plan for the school garden. The garden should be laid out on paper with the children in the schoolroom. For one thing, this will save time and confusion when the actual garden work is done. The plan on paper will also serve as a record for the next year in planning rotation of crops. Good farm practice recognizes the value of a good crop rotation. The school garden (and home garden as well) should illustrate sound farming practices.

Some of the factors to be considered in planning are ease of cultivation and irrigation; economy of space—the utilization of every available inch of ground; kinds of vegetables to be grown; the number of children doing garden work and their management by the teacher.

The questions to be decided in advance by the teacher are:

1. Shall I use the individual plot system?
2. Shall I use the dual plot system?
3. Shall I use the community plot system?
4. Shall I use the long row system?
5. Shall I use a combination of the long row and the community systems? See pages 8 and 9.

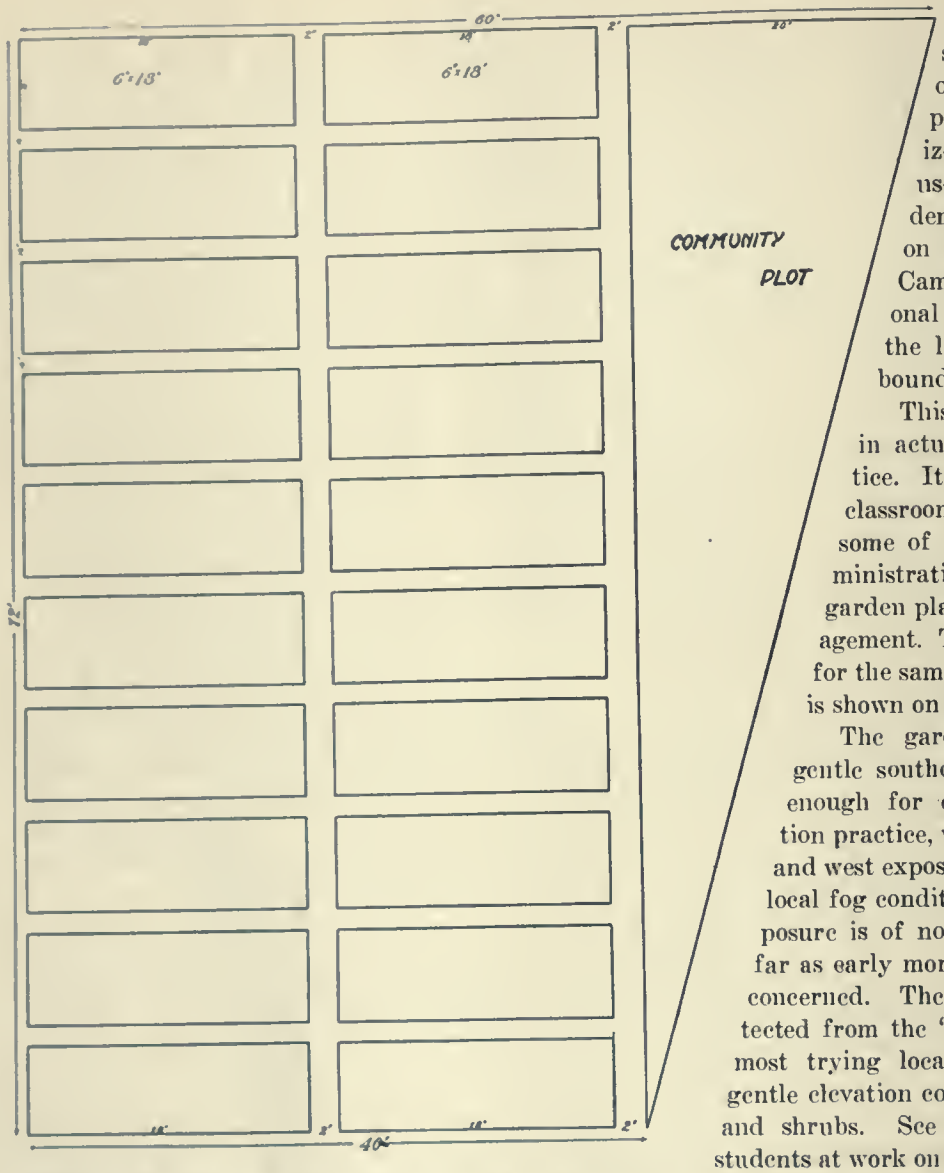
The plan on this page shows two plots of ground of equal area, 18 ft. by 72 ft. On the left the area is divided into ten plots, each 6 by 18 feet. The right area shows the long row system which may be used as a community garden or for individual assignment of a row or parts of rows. One plot, 6 by 18, is shown planted to the same kinds of vegetables as are planted in the area with long rows.

Which arrangement shows better farm practice in the utilization of ground?

How many more feet of each vegetable is grown in the long row than in the combined short rows in the individual plots?

How much ground in total area is lost in paths in the individual plot arrangement?

Which arrangement is easier for irrigation?

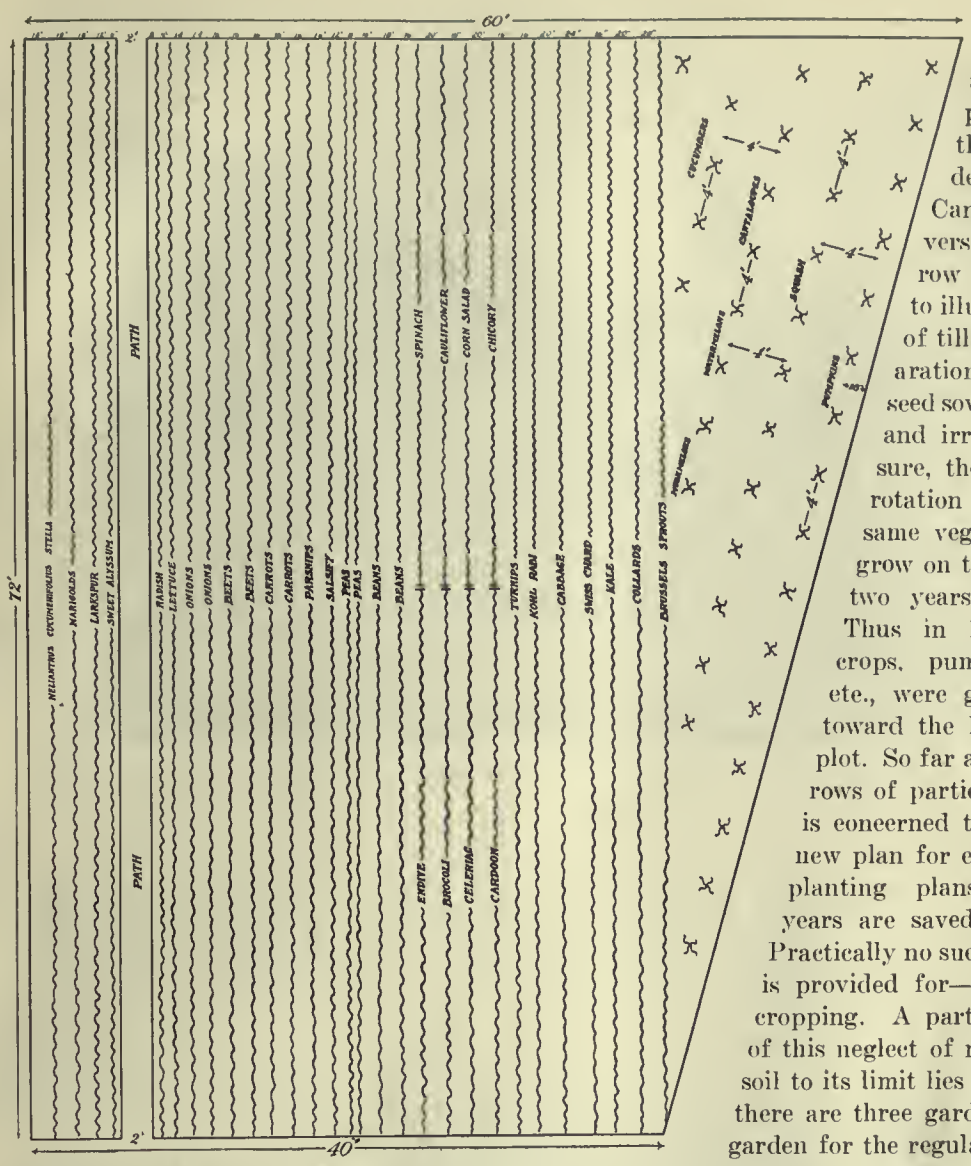


The diagram on this page shows one method of garden planning to utilize the ground used by the students' garden class on the University Campus. The diagonal on the right is the line of a fence bounding a roadway. This plan is not used in actual garden practice. It is used only for classroom discussion of some of the possible administrative problems in garden planning and management. The plan as used for the same area of ground is shown on the next page.

The garden site has a gentle southern slope—steep enough for excellent irrigation practice, with a full south and west exposure. Because of local fog conditions the east exposure is of no consequence so far as early morning sunlight is concerned. The garden is protected from the "northers" (the most trying local breeze) by a gentle elevation covered with trees and shrubs. See illustrations of students at work on following pages.

Space will not permit of a discussion of all the administrative problems connected with a plan like this. However, if a teacher has a gardening class of twenty pupils and wishes to use the individual plot system, the diagram offers probably as good a plan as any. The triangular space may be used as indicated, a plot belonging to the entire class where certain crops, as the vine crops, or certain perennials as rhubarb, asparagus, etc., may be grown.

It is not believed that a plot 6 by 18 feet is too large for pupils in either the 6th or the 7th or the 8th grade. We must get away from the 3 by 4 plot, the grave mound phase of gardening —the postage stamp phase of agriculture. Many boys and girls in their home war gardens cultivate a much larger plot. Even pupils in the first two grades will grow much better plants under like conditions in long rows than they will in cute little squares. The school garden as a phase of educational productive agriculture in methods and results should make a strong appeal to the average patron as something really worth while. However, there still remains the question of the practicability of the individual plot system when there is taken into consideration economy of space, ease of cultivation and irrigation, sound principles of agricultural practice, and the fundamental purposes of the school garden.



The diagram on this page shows the actual plan of work for the students' garden class on the Campus of the University. The long row system is used to illustrate processes of tillage in the preparation of the seed-bed, seed sowing, cultivation and irrigation. To be sure, there is practiced rotation of crops. The same vegetable does not grow on the same ground two years in succession. Thus in 1918, the vine crops, pumpkins, squash, etc., were grown far over toward the left side of the plot. So far as the placing of rows of particular vegetables is concerned there must be a new plan for each year. The planting plans of previous years are saved for reference. Practically no succession of crops is provided for—nor companion cropping. A partial justification of this neglect of not working the soil to its limit lies in the fact that there are three gardens, the spring garden for the regular students; the mid-summer garden for Summer Session students; and the autumn garden for the regular students. It has been found that this gives enough "succession" when it is recalled that with our open climate many vegetables can be grown all the year round.

The garden is used not only as a demonstration plot to illustrate sound principles in agricultural practice, but also as a laboratory to grow materials. So a few plants are grown each year for informational purposes. The aim is to grow the best plants possible, each good of its kind.

The garden is a community project, students working out each phase of the process. There are two or three good reasons why this seems to be the best way. The garden period in the schedule comes but once a week and is three hours long. The soil is a heavy adobe. If spaded up and allowed to remain very long it becomes very difficult to get into fine tilth for seed sowing. Moisture escapes and the clay becomes hard. The immediate administrative problems is to decide how wide a strip of ground running the entire length of garden can be prepared and sown in one laboratory period. If the task today is to put in four rows of onions, then all work together to get the seed bed in right condition and sow the four rows of onions. And so on for successive days until the garden is finished. For the past two years the crops have been harvested for the benefit of the Berkeley Red Cross.

The long row system has the merit of economy of space, ease of cultivation and irrigation, and is based on sound agricultural practice. Processes can be taught to all by the teacher; the harvest is for the common good, leaving to the home garden the development of individual enterprise.

B.—SOIL PREPARATION

The picture on this page shows boys at work on a vacant lot, the school garden site across the street from the schoolhouse. The time is early spring.

I. *Spring Preparation.*—The immediate steps (if no garden work was done the previous year) are: 1st, Clean off the rubbish if there be any. 2nd, When the ground is in the proper condition for working, plow to the depth of ten inches if a team can work on the karden site; if not then it must be dug up with forks to the full length of the tines. 3rd, Work the soil down to a fine tilth with rakes to hold the moisture.

II. *Fall Preparation.*—The soil of the vacant lot shown in the picture is a heavy, sticky, clay adobe, almost too difficult for children to work. It needs improvement to make the garden work a pleasure. The time to begin soil improvement for this particular type of soil is not the week before the seeds are to be sown but in the fall after the crop has been harvested. This particular type of soil needs lime and organic matter.

1. Lime: Previous references reveal the value of lime as a soil amendment, its effect on soil structure. (In addition see Circular No. 111, Lipman, The Use of Lime and Gypsum on California Soils, College of Agriculture, University of California). Only practical directions as to form of lime to use, how much to apply, and time of application are considered here.

(*a*) Burned or caustic lime is the best form to use on the garden. Diligent care must be taken that the lime does not come in contact with skin or clothing.

(*b*) Lime should be applied at the rate of two tons per acre. The lot shown in the illustration is 50 by 130, about one-seventh of an acre. This would require 600 pounds of lime.

(*c*) The best time to apply is after the first good rain. Spread evenly over the surface with a shovel and immediately hoe or rake it in so the wind will not blow it away.

2. Organic Matter: Preceding outlines and references give full explanation of the value and relation of organic matter to soil fertility and structure. When and what organic matter to apply is the practical consideration here.

(*a*) For this size lot and type of soil four good big loads of fresh stable manure with plenty of straw mixed with it (bedding for horses and cattle) should be evenly spread over the ground. Do this about a month after the lime was applied.

(*b*) Plow this manure under to the depth of ten inches. If site will not permit use of team with plow, then *spade* (fork probably too light, depends on moisture condition) under the same depth. The soil will turn up in great clods. No matter, leave it so to soak up the winter rainfall. The manure is rotting, the lime is acting and a great reservoir of water is accumulating.

3. Without lime or manure: Even if no lime and manure are applied, surely the ground should be opened up to take in the rain. Otherwise the most of it runs off the hard surface.

III. *Next Spring Preparation.*—As soon as moisture conditions will allow, plow or fork ten inches deep. Work down fine with rakes to hold moisture. If this be done well certain crops can be grown without subsequent irrigation, providing the growing plants have proper cultivation.

IV. *During Subsequent Years.*—One swallow does not make a summer and one application of lime and organic matter will not wholly transform an adobe soil. It is possible but not probable that too much manure may be applied to a school garden. There is no danger of applying four loads annually to a plot 50 by 130 if heavy crops are taken off each year. As for lime one application at rate indicated above once in two years for three or four applications will be ample. Teach the children the value of a sound system of soil improvement.

V. *Sandy and Loam Soils.*—Improvement of sandy soils has been discussed. (See outlines). Other things being equal, good tillage is about all that is necessary for a good loam. To be sure, sandy and loam soils may need line, not so much to improve the soil structure as to correct acidity. For garden purposes both types will always need organic matter. If barnyard manure is scarce, green cover crops (preferably the legumes) can be grown on these types if plowed under at the right time and in the right way.

"Meet to the mark are my furrows full-set."

To be able to plow a clean, straight furrow and turn a square corner has a deep moral significance. It is also evidence that the worker takes pride in his work.

Good plowing is an art and the ploughman may become an artist. For "art is the well-doing of what needs doing." There is no more important process in successful farming than good plowing. High standards of excellence should inspire children in garden work. Do as neat a job as this with the spading fork. Some day some man with a vision will write an appreciation of the plow as the fundamental tool in civilization.

Good tools are a means of education if properly handled and cared for. There is no pleasure in working with a rusty and dull implement. A grower of plants need not be a slave to the hoe. Thought must go with the use of a machine. There is a right way in using every garden tool shown in this illustration.

Tools for tillage are of two general classes. One class includes all necessary in the cultivation of the crop, or the tillage of maintenance. The rake, hoe, hand weeder and trowel belong in this class. In cultivation to destroy young weeds and especially for conservation of moisture no tool excels the rake. "Water your garden with the rake" is sound advice.

The one fundamental operation in agriculture or gardening is stirring and mixing the soil. The man in the furrow grasping the handles of his plow stands at the threshold of agriculture. Likewise the boy with the fork stands at the threshold of gardening. Turning over the soil may be a deadening exercise. But it is possible, through training, to acquire a spiritual contact with nature. The soil then becomes the holy earth and its control is full of satisfaction.

Daniel Webster said: "When I have hold of the handles of my big plow in such a field as this, with four yoke of oxen to pull it through, and hear the roots crack, and see the stumps all go under the furrow, out of sight, and observe the clean, mellowed surface of the plowed land, I feel more enthusiasm over my achievement than comes from my encounters in public life at Washington."

Later on in other illustrations will be emphasized the *curve of beauty* in landscape art. If, as Millet claimed, beauty is expression, in doing a useful thing in the right way, then there is art in digging in the garden. The *curve of beauty* in this figure of the boy digging is a line beginning at the boy's collar, running along his back and terminating at his right heel.

The preeeding illustration shows the first operation the fork forced into the ground the full length of its tines. The seeond is to lift the forkful of earth, invert it, and hit it two or three smashes with the back of the fork to pulverize the big elods. A good plow inverts the furrow sliee and covers trash. It must also do a part of the "fining" of the soil and leave it in sueh a eondition that the harrow ean finish the work in the most effeetive manner. Pulverizing eaeh forkful makes it easier to use the rake most effeetively.

This is all the more necessary for this particular type of soil, whieh is a heavy, stieky, waxy adobe. The lump on the boy's fork faintly reveals its character. There is a "psyehological five minutes" when this type of soil may be handled with a near ease and pretended pleasure. It needs lime and organic matter.

If the soil were turned up in big lumps and allowed to lie so for a few hours or until the next day, the wind and sun will have evaporated the moisture and the lumps of this kind of soil beeome almost as hard as roek. Consequently the soil should be fined down with the rake at the elose of each digging operation. Do not wait too long to use the rake. The importance of this phase of the preparation of the seed-bed eannot be overestimated.

There is also the art of raking. Notiee the *curve of beauty* in this figure. The utility of the hinge joint at the elbow and the play of museles in the arm are left to the imagination of the observer.

The soil appears in excellent tilth "on the surfaee." The next step is to locate the rows and determine distanees between the rows. A planting guide as printed in any reliable seedman's vegetable garden manual is invaluable for the beginner.

A straight line is the shortest distance between two points. For one thing it is eeonomy of ground to grow straight rows of plants. Straight rows are easier to cultivate and to irrigate espeeially. The appearance is mueh better when plants are growing. High standards of excellenee should be maintained in the meehanies of seed growing as well as in the meehanies of writing or drawing in the sehoolroom.

The ground did appear in very good eondition "on the surfaee." The making of the seed furrow revealed that the "fining" of the soil by the rake is not quite deep enough. The finer the soil partieles in eontaet with the seed the better. The root hair of a growing plant eannot easily get its food from a elod. Too mueh emphasis cannot be plaeed upon the necessity of a deep, mellow seed-bed. However, considering the nature of the soil, the boys made good use of that "psyehological five minutes."

This is one way only of making the seed furrow. It is not as easy as it looks, to keep the point of the hoe under the line and to make a elean, straight furrow without disturbing the line.

"Meet to the mark are my furrows full-set" may be expressed by this boy with the hoe as well as by the man over his plowing, as shown on bottom of page 29.

Note that the rake when not in use lies "points down."

How deep must seeds be planted? A eommon rule is to put seed into the ground to the depth of twiee the longest diameter of the seed. But as the gardener must co-operate with nature, whose mood varies, other faetors than the size of the seed must be eonsidered. The depth also depends upon the eondition of the soil as to fineness and moisture, the temperature of the air and soil, and the way the seed germinates. These things are learned by observation and study.

The seed should be planted thiek enough to insure a good stand. When planted fairly thiek the eombined action of several seedlings ean break through the erust of earth (possible after a shower of rain) easier than a single plant. Of eourse, the plants should be thinned to the proper distanee apart in the row.

If the soil is in the right eondition as to fineness and moisture and if the seed furrow was made to the right depth, then enough fine soil should eover the seed to fill the furrow. The soil over the seed should be firmed with the hoe as the boy is doing. This paeks the fine partieles of soil around the seed and thus restores eapillary aetion and exeludes the air while the seed is germinating. If the soil were not firmed air would enter in between the loose partieles and evaporate the moisture.

The degree of firmness over the seed depends upon the eharaeter of the soil. Light sand and loam with plenty of organie matter will permit more pressure in firming. Heavy elay soils (with mueh moisture) will permit gentle pressure or none. If a erust tends to form (after a rain) this should be broken gently with a rake.

IRRIGATION: As has been stated, if the preparation and improvement of the soil has been of the right character, and if the cultivation of the growing plants is such to maintain the earth mulch and thus conserve moisture, an early spring garden of certain vegetables can be matured without irrigation. A few others may be matured later in the summer without resort to irrigation. All this, however, presupposes a perfection of husbandry possibly quite beyond the average child and for school garden conditions. Hence the need of the application of some water.

The sprinkling can has a very limited use in California vegetable growing. The ground must be soaked with moisture where the roots are and where the fine root hairs are feeding.

The long row system of gardening permits an irrigating furrow to be made the entire length of the row near where the roots are. This can be done with the corner of the hoe blade. Then turn the water in and permit it to flow gently, thus giving time for the moisture to soak down to the bottom of the roots. In the illustration a boy is using a sprinkling can (spray removed) to pour water into the furrow. Thorough cultivation should follow at the proper time.

The above illustration shows a vacant lot school garden. It is the kind of a school garden that appeals to the public taxpayer and school official. It shows good farm management in that there is no waste land. Every inch of ground is utilized. A narrow path leads across the lot. An old bay mare, which the writer used with a single line and a double shovel in his first corn cultivation, could walk in a path sixteen inches wide. Boys and girls can acquire the same dexterity.

Again, long rows lead across the field in either direction from the path. This makes it easier for irrigation and cultivation.

Good agricultural practice is shown in the absence of weeds, soil in good tilth, and plants in thrifty growing condition.

The boy with the hoe and the girl with the hoe manifested pride and pleasure in the farm.

"Dux femina facti,"—A woman was the leader of the enterprise—said the Latin poet Vergil. This was not said in connection with school gardening nor agriculture, although he sympathized with agriculture and wrote about it. But in the garden enterprise shown above a woman is the leader. She is the teacher in command of a platoon of the Army with the Hoe, the Children's Crusade in increasing food production to help win the war.

The girl with the hoe in her bean growing project, a war garden in her backyard. Health, grace and skill are shown in the worker and her work. She also has rabbits and poultry. This will not of itself win the war. But it will help. If this girl could be multiplied by two million other girls and boys, many of whom are worse than idle during the long vacation, it would mean a big help in food production.

Extremes in education sometimes work together for a common purpose. This illustration shows the vacant lot war garden cultivated by a school principal and his janitor. One aim is to show that certain crops can be grown on this type of soil (heavy black adobe) without irrigation. Crop of potatoes, sweet corn, and beans in thrifty condition on June 12.

A potato war garden. Every inch utilized.
Read the poem—Boy with the Hoe.

BOY WITH THE HOE

Say how do you hoe your row, young chap?
Say how do you hoe your row?
Do you hoe it fair,
Do you hoe it square,
Do you hoe it the best you know?
Do you eut the weeds, as you ought to do?
And leave what's worth while there?
The harvest you'll garner depends on you;
Are you working it on the square?

Are you killing the noxious weeds, young chap?
Are you making it straight and elean?
Are you going straight,
At a hustling gait,
Are you seattering all that's mean?
Do you laugh and sing and whistle shrill,
And danee a step or two.
As the row you hoe leads up the hill?
The harvest is up to you.

—*Seleeted.*

Easter egg shell gardens for the primary people, the Little Soldiers of the Soil.
Each garden may cause a life to awaken to a new purpose.

Students in Agricultural Education of the University of California receive practical training in the art of gardening as well as lectures and library readings on what may be termed the theory and pedagogy of gardening. There is opportunity for garden work for the regular session students in the spring; for Summer Session students; and also for the regular session students in the fall.

The illustration above shows a spring garden class preparing the seed-bed. The plan for this particular garden is shown on page 27. Rotation of crops is practiced from year to year.

The soil is a heavy adobe. No soil improvement had been made previous to this particular class work. Since then a plan of soil improvement is being carried out, in the main as outlined on pages 28 and 29.

The spring preparation for this garden consisted only of plowing the ground at the close of the rainy season and dragging (harrowing) it. In case a light shower of rain followed, then the disc was run over it to break the crust.

The class then forked up the soil to the full length of the fork tines. It was then worked down fine as possible with rake and hoe, and seed planted. Class and instructor worked together in every process.

Processes are worked out in accordance with sound agricultural practice. There is no more important single operation in farming than tillage of preparation. Perhaps more gardens fail along this line than from any other phase. The tillage should aim to secure:

1. A fine, even surface of the garden, so that equally vigorous plants may grow over the entire area.

2. To develop a deep, mellow seed-bed, a fine home for the roots of plants, with a large storage capacity for moisture and available plant-food.

3. To bring about the best structural condition of the soil, so that roots of the crop may have fullest development.

The tillage of maintenance (cultivation) must destroy the weeds, provide for proper irrigation and the earth mulch for conservation of moisture.

Class transplanting cabbage plants in the garden after growing them in flats in the greenhouse. See references on Growing Plants for the Garden and Transplanting, on pages 7 and 8, Part II, The Home Garden and Vegetable Growing Project.

Cabbage plants six weeks after setting out. From left to right, Brussels sprouts, Broccoli, Cauliflower, Early Jersey Wakefield, Early Flat Dutch, Copenhagen Market varieties of cabbage. Long rows make for ease in cultivation and irrigation.

Here is shown a July garden by the Summer Session students—public school teachers—in Agricultural Education. The ground had to be irrigated before it could be dug up with forks. The soil was worked down with rakes and hoes and the seed furrow made. Water was run into this furrow before seed was sown; the seed then covered lightly with dry earth. To insure sufficient moisture for germination a small furrow was made (in two or three days after planting seeds) between the rows of plantings. Water was turned into the furrows and soil filled with moisture under the seeds. The illustration shows the class cultivating the third day after the irrigation.

Summer Session students, in addition to planting a garden, get some practice in the irrigation and the cultivation of growing plants. The illustration shows a spring garden planted by the students of the Regular Session. It is now being worked by the Summer Session students. The path—the only one in the garden—is two feet wide and used as a "run way" by many persons not connected with the garden class.

The emphasis here is placed on *deep and thorough cultivation.* Read the classic, "The Man with the Hoe," in Wickson, *The California Vegetables in Garden and Field.*

"There is little grace, we admit, in the attitude of the Italian market gardener, as he straddles the row, arches his back and grunts as he sends his heavy mattock its full depth into the soil around the plants. The American with his fine, new, full-width, bronze-shanked, green-labeled, steel hoe, marching along the rows, touching the soil with disdain as ill worth exertion on his part, is a much handsomer picture. But the Italian's plants laugh at drought. When irrigated the soil takes water like a sponge and it goes plump down to the roots of the plant. Irrigate the shallow-hoed plat; a pailful will run a rod an the plant root gets but the gurgle of the water as it flows along the surface of the hard-pan just beneath the dust."

"In all the range of vegetable products I doubt whether there is a more perfect example of pleasing form, fine modelling, attractive texture and color, and more bracing order, than in a well-grown and ripe field pumpkin. Place a pumpkin on your table; run your fingers down its smooth grooves; trace the furrows to the poles; take note of its form; absorb its rich color; get the tang of its fragrance. The roughness and ruggedness of its leaves, the sharp-angled stem strongly set, make a foil that a sculptor cannot improve. Then wonder how this marvellous thing was born out of your garden soil through the medium of one small strand of succulent stem."—Bailey on "The Admiration of Good Materials" in *The Holy Earth.*

"At harvest time in our country I hear, or imagine I hear, a sort of chorus rising over all the hills, and I meet no man who is not, deep down within him, a singer! So song follows work; so art grows out of life!"—Grayson, *Adventures in Contentment.*

The products of the 1918 student garden, about one-quarter of an acre in area, netted the Berkeley Red Cross $333.94.

D.—THE SCHOOL GARDEN AND LANDSCAPE ART

For most of us the Expositions held at San Diego and San Franeiseo are but a memory. One lesson to be learned from those Expositions is the artistie arrangement of trees, shrubs, flowers and vines to improve the environment of loeal eommunity life. The sehool garden as a means of beautifying the sehool grounds ean emphasize the *"Exposition Way"* in plantings.

The basal prineiples in landseape art along natural lines are: "Open Spaees," "Plant in Masses," and "Curved Line Effeets," sometimes ealled the ABC of planting. The ehildren should be taught the alphabet of beauty.

In the Exposition view shown above two prineiples are well illustrated and the third suggested. "Plant in Masses" is seen in the grouping of shrubs and flowers along the building to sereen the foundation and to tie the house to the lawn. "Open Spaees" is suggested in the lawn, an effeet better shown on the next page. "Curved Line Effeet" is seen in the wavy line where the border of the planting meets the lawn.

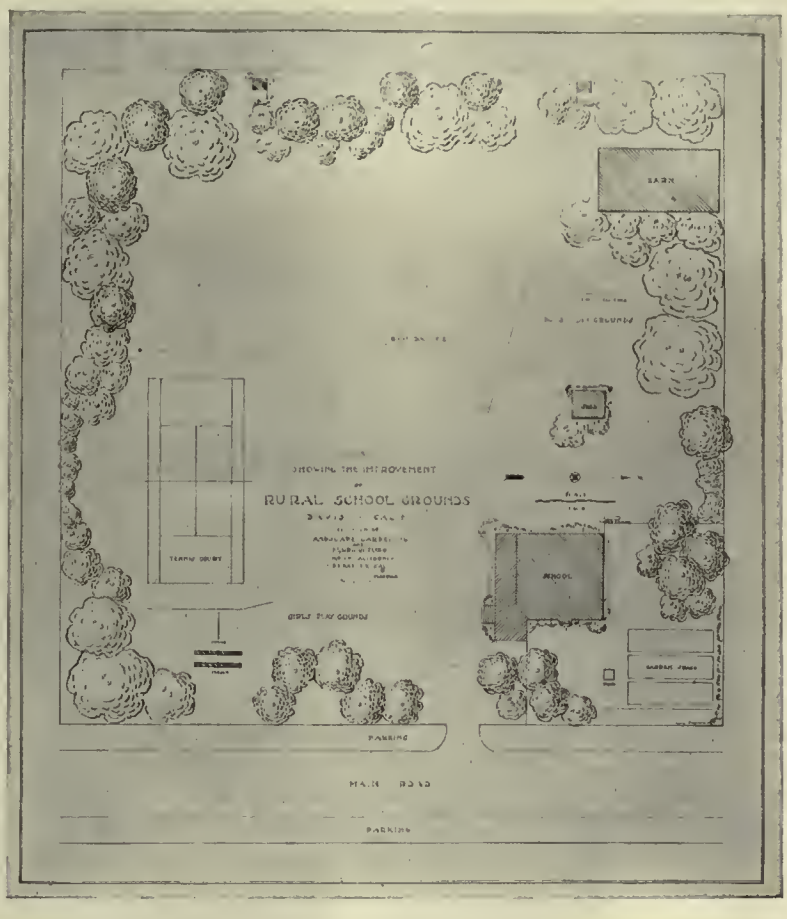
Ruskin eonsiders the eurve (not the eirele) the most beautiful of all lines. "That all forms of aeknowledged beauty are eomposed exelusively of eurves will, I believe be at onee allowed; but that whieh will need more espeeially to prove is, that subtlety and eonstaney of eurvature in all natural forms whatsoever."—Modern Painters.

In this Exposition view the "Open Center" is emphasized. There is also the massing of shrubbery along the edges of the lawn. The curved line effect of shrubbery planting is lost in making the photograph. Note the effect of vines along the arcade.

The "Exposition Way" is not to scatter trees, shrubs and flower beds over the lawn in a "pepper and salt" effect. One may scatter foreign and artificial shrubs and trees over a lawn but neither a beautiful picture nor a satisfying effect can be built up in that way. It is not necessary to sacrifice a playground to have an attractive playground. "Civic art, the expression of civic life, is too often understood to consist in filling our streets with marble fountains, dotting our squares with groups of statuary, twining our lamp-posts with wiggling acanthus leaves or dolphins' tails, and our buildings with meaningless bunches of fruit and flowers, tied up with impossible stone ribbons."—Raymond Unwin.

The "Exposition Way" emphasizes Nature's way. The landscape artist goes to Nature for his inspiration. The river winding down the valley illustrates the fundamental principles of landscape art along natural lines. The water represents "Open Spaces"; "Mass Effect" is seen in the way Nature covers the banks; and the "Curved Line Effect" is seen in the winding of the stream as it flows down to the sea.

The "Exposition Way" emphasizes the spirit of stream and forest. In tree planting on Arbor Day it is possible for the children to get some significance of the matchless beauty of the primeval forest. "One vast, continuous forest shadowed the fertile soil, covering the land as the grass covers a garden lawn, sweeping over hill and hollow in endless undulations, burying mountains in verdure and mantling brooks and rivers from the light of day. Green intervals dotted with browsing deer, and broad plains alive with buffalo, broke the sameness of the woodland scenery. Unnumbered rivers seamed the forest with their devious windings. Vast lakes washed its boundaries, where the Indian voyager, in his birch canoe, could descry no land beyond the world of waters."—Francis Parkman in *The Conspiracy of Pontiac.*



The "Exposition Way" of planting is well shown in the above plan for beautifying a country school grounds. The design was made by the Division of Landscape Gardening and Floriculture of the University of California.

The schoolhouse is well located, being placed to the right and to the front of the school grounds. Thus a large open center is left for playground activities. It is well enough, perhaps, to place a city hall or a courthouse in the center of a square, with avenues from the four corners leading up to the building. Such would not fit into country life.

The planting material in the above plan is massed around the border of the school grounds in curved line effects. On the upper border are the outbuildings appropriately screened. The unsightly barn is screened from view. Shrubbery is planted around the foundations of the schoolhouse. Provision is made for school garden activities in the lower right hand corner. The entire grounds may be used as a garden to develop an appreciation of good landscape art.

The above presents an opportunity to practice the "Exposition Way" and thus help to make a more beautiful California country life. The spirit of the forest is present in the fine oak tree.

Notice the tall, bare, sharp corner of the building nearest the tree. The "Exposition Way" is to harmonize the two by the massing of appropriate shrubbery around the corner of the house. The sharp outlines are thus softened. See treatment of a corner on page 48.

Shrubbery, in the "Exposition Way," should be planted along the front and right side of the schoolhouse. See pages 43 and 45. For descriptive list of a few good shrubs see page 19.

Vines should cover the arcade. See effect on page 44. For descriptive list of a few good vines see page 22.

The barn can be screened with tall shrubs, perhaps transplanted from the countryside. See suggestion in plan on page 45.

One Way of Observing Arbor Day.—"We planted three ash, three elm and seven box elder trees. Set Boston ivy along stone school building, woodbine along back fence and closets. Also planted eleven Spirea Van Houttei, two Weigelia and eight lilacs."

Another School.—"Many shrubs set out: forty sumach, ten elderberry, two mulberry, four bush honeysuckle, a Syringea, an Hydrangea and an elm tree."

Above is shown the "Exposition Way" of planting flowers along the foundation of a school building. The long, curved line on the lawn is such a curve as one sees in Nature when the wind blows over a field of wheat or the waves of the sea roll in over the beach. The effect above is much more artistic than if the same number of flowering plants were put in a circular flower bed in the middle of the lawn.

The tall, flowering plants are the common hollyhocks. These old-fashioned flowers—beautiful nevertheless—need just such a situation as shown above for best effect. They have an appropriate background and are protected from the twisting effect of the wind when planted in the open. More of the hardy annual and perennial flowers should be grown on country school grounds.

The "Exposition Way" emphasized flowers as well as trees, shrubs and vines. Along the winding walk leading to Denmark's building at San Francisco was a bed of fine flowers, golden yellow, the common marigold. Dignify the common things of life, for after all it is the common thing that is fundamental.

"We made a garden of dahlias, morning glories, sweet peas, asters, nasturtiums, marigolds and California poppies."

"We planted a flower garden of salvia, pansies, nasturtiums, sweet peas, pinks, phlox and poppies."

"We planted sweet peas, hollyhocks, pansies, asters and four o'clocks."

"We planted sunflowers, cosmos and wild cucumber to screen out-buildings."

"We planted three flower beds, one of California poppies, one of asters and one of Zinnias."

"We made a flower bed of perennial phlox and columbine. About one hundred packets of seed were distributed for home garden work."

The "Exposition Way" is shown in the plantings around the new buildings on the Campus of the University of California. The above illustration shows a detail at the corner of the new Benjamin Ide Wheeler Hall. On the next page is shown the landscape effects along the side of the Wheeler Hall (right) and the addition to the University Library (left). Plantings also have been made around the new Hilgard Hall in the Agricultural Group.

The photograph was made two months after the shrubbery was set out in 1917.

The planting material around the sharp corner of the building above and along the foundation from the first window on the left (near center of illustration) to the first window on the right is as follows:

24 Myrtus communis } Myrtle
24 Myrtus luma }
5 Pittosporum crassifolium.

From the window in the corner, going to the right along the wall to the sidewalk along the front entrance to the building:

1 Taxus baccata fastigiata (Yew)
22 Ligustrum sinensis (Privet)
15 Euonymus japonicus (Burning Bush)
18 Erica mediterranea (Heath)
6 Myrtus luma.

Along the edge of the sidewalk in the foreground:

20 Myrtus luma
38 Berberis stenophylla (Barberry)
1 tree Pantanus orientalis (Oriental Sycamore).

All the shrubs made a rapid growth and many were pruned in late summer of 1918.

THE CLOCK STRIKES TWELVE AND THE CHIMES RING AMERICA

High ideals of literature, seienee and art are set forth in laboratory and lecture room. On the campus, with "eyes right," "eyes left," the student body may see that the University of California eonsiders it an "equal obligation" to express art in good landseape.

"The natural landseape is always interesting and it is satisfying. The physieal universe is the source of art. We know no other form and eolor than that we see in nature or derive from it. If art is true to its theme, it is one expression of morals. If it is a moral obligation to express the art-sense in painting and seulpture and literature and musie, so is it an equal obligation to express it in god landseope."—Bailey, "The Keeping of the Beautiful Earth" in *The Holy Earth.*

"I will lift up mine eyes unto the hills, from whence cometh my help."