TEACHING BY PROJECTS

THE MACMILLAN COMPANY
NEW YORK · BOSTON · CHICAGO · DALLAS
ATLANTA · SAN FRANCISCO

MACMILLAN & CO., LIMITED
LONDON · BOMBAY · CALCUTTA
MELBOURNE

THE MACMILLAN CO. OF CANADA, LTD.
TORONTO

TEACHING BY PROJECTS

A BASIS FOR PURPOSEFUL STUDY

BY

CHARLES A. McMURRY

New York

THE MACMILLAN COMPANY

1920

Set up and electrotyped. Published January, 1920.

Norwood Press
J. S. Cushing Co. — Berwick & Smith Co.
Norwood, Mass., U.S.A.

STATEMENT OF NEEDS

We need to organize knowledge into complete wholes or projects, looking toward well-conceived, purposive ends.

We need to discriminate in teaching between bare facts and constructive projects, around which facts are gathered and centered.

We need to economize time and avoid waste by organizing instruction.

We need to avoid what is vague and merely abstract.

We need a better basis, in large instructional units, for planning lessons and for executing class-teaching.

We need to consider knowledge not as formal and static but as progressive and dynamic, *i.e.*, as contributing to the growth of ideas.

We need to start out in every new subject with full, keen, relishable knowledge and, on this basis, to provide for steady growth and organization into large units.

We need to practice the use of knowledge at every turn, first by directing attention to what is serviceable and, secondly, by using it in the realization of projects.

We need to put a far richer meaning into common, familiar topics which are types for later growth and expansion.

We need to simplify, organize, and enrich every important topic or project until it reaches the stage of a complete achievement.

TABLE OF CONTENTS

TEACHING BY PROJECTS

CHAPTER I

PROJECTS IN THE SCHOOL

PROJECTS are of two kinds:

First, the child's project undertaken at his own behest when he is pressed by a felt desire or need, *e.g.* the bird house, the rabbit trap, a homemade telephone. **Two classes of projects**

Secondly, the projects of others which the child appropriates, into which he is easily drawn, and to which he gives his undivided attention, as the invention of the cotton gin, the planning of a canal lock, or improving the harbor of San Francisco; or he is absorbed in Crusoe's projects of cave-making, boat-building, and taming of animals.

There is a wide range to the first kind of self-chosen projects that a child falls upon, from doll dresses, sleds, tree-houses, or camping trips, to the dramatizing of a tale and even the writing of a story or poem. There is a still wider scope and bigness to the projects of the second class that he appropriates from without, and both sorts happily open the way into important school studies. Even a child's games show how easily he passes beyond his own small projects to those of his elders, as in hunting, gardening, and house building. He participates freely in the projects of men exploring new regions, as Boone and Frémont; or Fulton building and exhibiting the first steamboat; or Captain

Eads constructing the jetties to open a deep passage at the mouth of the Mississippi. These projects which men and women, active in the world, are pushing to completion, are appropriate and engaging subjects for young people who are just opening their eyes to the big things in life, as, Livingstone opening up Central Africa, the Red Cross busy in relief work, Cornell founding a university for the people, New York City constructing its huge aqueduct from the Catskills for supplying its vast population with water. Industrial and scientific projects in mining, in agriculture, and in sanitation are the choice enterprises for children. Even big government projects in irrigation and canal construction engage the mind in genuine thought problems.

In the impulse to adjust themselves to the larger world, children find themselves involved in these important projects whether developed in the past or now opening up in life about them.

Educationally considered, we believe a child is at his best when planning and executing his own projects, or at least those which engage his full powers. Adult men and women also in active undertakings are at their best when working out effectively important business and other projects. Even society, in its larger organizations, is at its best when engaged energetically in developing and executing social projects. In all these cases the project has the merit of a self-directed organization of mental and physical resources to achieve a well-considered result. The larger projects of adult life and of social and industrial progress have the additional merit that they tax the serious thought powers of children. They are real problems resting upon a practical basis of life experience.

Value of projects

They also stimulate and require a sustained effort in thinking.

Whether the child is engaged in his self-chosen project or makes his own some bold and difficult undertaking of another, the motive and energy of thought are much the same. The project itself is a natural summons to ambition and effort, an impulsive forward movement in purposeful thinking, and yet objective, and oftentimes even dramatic and spectacular. These project-problems, expressing the strain of thought and effort to master the forces of environment, lead more directly into life conditions as they are than any other studies.

There is a close and necessary connection between the self-chosen projects of the child's small world and the large projects of the life beyond. The smaller problems are a prelude to the major ones soon to follow, to which they are so closely akin in motive and in spirit. Children should be induced to work out as many of these self-chosen projects as may be feasible in order that they may take on the problem-solving attitude with respect to the larger, more complex problems whose solution may be thought out.

It is a truism of our educational creed that sensory impressions based on object lessons and motor response form the primary basis of thought in dealing with the later materials of knowledge. The project conceived and executed by the child on the ground of his own experience is a still better basis for our educational efforts because it sets up in children self-determination and purposeful activity in a complete, natural, and well-rounded unit of effort. This kind and quality of constructive thought can be carried forward into later studies and into life as a fundamental method of exploring, organizing, and using knowledge.

The object of a good course of study is to allow the children to grow into and identify themselves with the enterprising projects which men, past and present, have found most essential to their welfare and progress. The child's own little projects are very essential beginnings in this fundamental process of appropriating and using knowledge and experience directed by himself toward useful ends. The best devices of instruction may be turned into this channel where children are led to the self-appropriation of those larger projects in which wiser heads, active in the world, set their chief store.

Growth from individual to social projects

While the larger projects of the world just outside of the school have a powerful attraction for children, it is of equal importance to repeat and emphasize the approach to these projects out of the child's experience so that the projects of his own making grow into the larger schemes of life. Contact with life at both ends is essential, first in a rich child environment, and secondly in a richer, better-organized social environment beyond the school walls. The world's experience and wisdom are gathered up and organized into these successful projects. They express the growing stages, the actual evolution of the main life processes in a practical world.

In plying his trade among school children the teacher must be a full master of both kinds of experience, the individual and the social, constantly playing back and forth between the two, establishing thus that steady continuity of growth into a larger experience which makes education all of one piece.

On this basis it is necessary for the teacher to study the big world and its dominating projects quite as closely as the child, his tendencies, and activities. This cannot be

called an easy program for the teacher. But it is at least an opportunity to sound the depths of our real problem of education and to turn our effort into the main current of progress in the teaching art.

The term *project* belongs in one sense to the language of business, — or of plans and schemes in active life. It is an echo from a noisy world, an intrusion upon the quiet of the school, like a sharp train whistle or a noisy street wagon. But our drowsy school work may need this influx of noise and disturbance from without. At any rate the school is being brought into sharp contact with real life. In the school program itself, the children are learning to understand and adjust themselves to life surroundings and to take in the full meaning of the schemes and forces that are shaping society outside of the school.

Projects reflect real life

In taking over these life projects and adopting them into a plan of instruction as units of thought and effort, we find in them two striking qualities that fit the needs of teaching. First, they are objective and practical, not theoretical and vague. Big projects like the power plant at Muscle Shoals, the Panama Canal, or the jetty improvements at the mouth of the Mississippi stand out as commanding objects of attention. They are worth an examination. Secondly, such a real undertaking establishes a center of purposeful effort which develops rapidly into a fruitful, progressive subject of study. Around this definite, tangible center the materials of knowledge begin to collect and organize and thought has plenty of stuff to work upon.

The term *project* as we are using it has a wide scope and is applicable to a variety of undertakings in several important studies. It may be worth while to particularize

in some detail the wide range of capital projects which the school may now find profitable as standard units of mental effort.

First: There are simple, objective projects of the hand-work type. We are familiar with them in the larger and smaller constructions of the shops, for example, in textile fabrics, in wood work, in book binding and printing, in pottery, and in many related home undertakings such as repairs, reconstructions, and sanitary appliances. To the same group belong plans for school and home gardening, agriculture and fruit growing, chicken raising, dairying, and other specialties. The household arts supply another group of definite projects in laundering, sewing, cooking, and millinery, in house decoration and furnishing. In some schools there is a tendency to extend school credits to these home enterprises and accomplishments. These shop-and-farm and household projects have both a marked educational value, and a clear, practical utility. They require a distinct forethought in planning and designing, resourcefulness in meeting new and untried situations, persistent purpose and industry in executing plans, and, finally, a proper use of the results or products. Not many school exercises of the old stripe combine in one strong series of efforts all these merits and advantages.

Shop and home projects

Secondly: The study of geography supplies a profusion of big, tangible projects of conspicuous importance in human affairs, as projects in bridge construction, in railroad engineering and mountain tunneling, in expensive mining operations, in the survey and building of canals, in dealing with extensive forest reserves, in planning city waterworks and reservoirs, in irrigation schemes on a large scale, in installing great water powers

Industrial and commercial projects

at dams and falls in rivers, in laying ocean cables, in building subways, in improving harbors, in regulating rivers by levees and jetties, in the drainage of swamp areas, in great corporations for the conduct of business on a vast scale, as steamship companies and railroad systems. We are now discovering that these large municipal, governmental, and industrial projects are in themselves complete and well-organized units of study, the best sort of standard topics for schoolroom instruction. The school can well turn its attention to these enterprises because they are so largely shaping life about us; they are dominant in their influence upon the occupations, the homes and surroundings of thousands and millions of our people. They are the things that children desire to know and understand. Experiments in the full school-treatment of these topics have also demonstrated that they have a peculiar suitability to the thinking power and interest of children.

In another and quite different way nature herself works out on a large scale projects which we study in geography, as the sculpturing of a river valley, the work of a mountain glacier, the course and influence of an ocean current, the regular circulation of winds and moisture upon the earth, the course and movements of a cyclonic storm. These may be called natural units of study, displaying nature's big patterns or designs, by which she works out her projects in making the earth a fit dwelling place for man.

Thirdly: A third group of projects has a more distinctly scientific origin. Inventions and discoveries based upon scientific principles are embodied in steam engines, wireless stations, power plants, great telescopes, electric motors, mining and smelting processes, lightning rods, hydrostatic presses, steam dredges,

Projects in applied science

and water filters. Scientific processes also are applied to the ventilation of buildings, to hospital and surgery practice, to the propagation of plants, the extraction and preservation of foods, to the fertilizing of soils, to the bacterial treatment of diseases, to quarantine and sanitation. Applied science is full of big, comprehensive projects for turning scientific knowledge into use in commerce, in war, in aviation, in agriculture, in animal husbandry, in navigation, in the extraction and use of metals, in electrical appliances, and in medicine.

It is in these very projects, objective and directly practical in their bearings, that children are best able to see the meaning and value of modern science in its influence upon life. What children in elementary schools need is not abstract scientific principles, not the systematic study of any or all the sciences (an impossible thing), but simple, objective, convincing demonstrations of the main ideas and uses of science in the home and neighborhood and in the larger world beyond. What could be better for children than to allow them to see these tangible projects developing and working out their proper, practical influence upon the conditions of life that surround them? These are preëminently needful and instructive topics that should be given the right of way in the elementary curriculum.

Projects in biography and history

Fourthly: Many of the stories and undertakings described in biography and history are large personal or national projects in the full meaning of the term. For example, Columbus' first voyage, the Panama Canal, Alexander's first campaign into Asia, St. Paul's missionary journeys, Grant's movement against Vicksburg, the Lewis and Clark expedition up the Missouri and across the mountains, the voyage of the *Mayflower*,

Livingstone's explorations in Africa. In a large interpretation, history consists of an account of men's important projects in the building of cities, in the founding of states, in legislative programs, in reform movements, in founding institutions and societies, in warlike conquest, in territorial expansions, in the development of traffic routes and commercial policies. Especially in the story of leading historical characters do we find the personal impulse strong to execute some scheme or propagandist idea, some notion of progress, as illustrated in Hamilton's plan for funding the national debt, Field's project for laying the first Atlantic cable, Stanley's search for Livingstone, Howard's scheme of prison reform, Franklin's proposed Albany plan for the union of the colonies, Jefferson's purchase of Louisiana. The enthusiastic personal element that plays through these individual yet social projects lends an unusual strength to such topics. The man's life and energy are absorbed into and identified with the undertaking. He becomes a powerful and living exponent of a national or world idea. For instructional purposes such projects, thus reënforced by personal, objective demonstration, are of surprising value. We can afford to work out such projects descriptively and more or less exhaustively till we find a full background for the main idea, the completed purpose.

Fifthly: The masterpieces of literature are the outcome of thought projects conceived and elaborated in the minds of authors, for example, Plato's *Republic*, St. John's *Gospel*, De Foe's *Robinson Crusoe*, Shakespeare's *Macbeth*, Longfellow's *Building of the Ship*, Fiske's *Critical Period of American History*, Plutarch's *Lives*. A drama or novel or poem is the energy of the author's thought working itself out and

Masterpieces in literature considered as projects

projecting itself into a great thought-movement. It is active and stimulating, and yet is caught and held somehow in a permanent artistic form. A masterpiece is a tangible literary project, a rational undertaking looking toward a well-planned achievement. Literary products are the greatest projects of the human mind and as such they are the best examples of great thought units, of knowledge rightly organized and artistically grouped. As perfected, energized thought-movements, complete units of effort, they demand thoughtful, elaborate, progressive study. The outcome of such study is a full appreciation of their constructive, dynamic quality and their final unity.

By a survey and comparison of these various interpretations of the term *project* as seen in the several studies, we may conclude that it is a practical, untechnical word with which to designate a variety of big, vital topics. It lays stress upon the actual and objective in present and past experiences. It deals with an energetic, growing idea, concretely embodied, that expands into a strong, even, national influence. Projects force attention upon the main objects of study, the chief enterprises that make up the warp and woof of real life in our times.

A return to life and reality

At the present moment we need to be jolted out of our conventional, formal school phrases and to find terms better adapted to the educational needs and forces of the hour. The term *project* is a newcomer among educational phrases. It seems to suggest not the school but the shop, not the textbook but the busy mart, the industrial life, the unhallowed things of the schemer and the promoter. Perhaps this is its merit, that it forces attention upon things that have come to importance in life, things which need to break over the threshold into the

school. The project idea suits our present needs because it tosses aside our conventional abstractions and sets up a larger practical unit of knowledge as the basis of study. We have been dealing with things of minor import till we have lost sight of the centers of thought, the big object lessons. We have devoted ourselves to facts, mere facts, isolated facts, — yes, detached and meaningless facts. The children have been surfeited with facts. But it is time to stop making collections of blank cartridges and begin to gather only those things that have explosive material in them. Again, we have played with school phrases and generalities and summaries till they cease to express thought. It is time to cast out this mummery and to deal with live thoughts embodied in real projects.

The term *project* suggests a return to life, to business, to applied science, to daily duties and common human needs, to forces operative in the concrete world. The school is absorbing into itself as fast as it can the big things of life, the schemes that men and women are chiefly concerned about, and these are becoming our school topics. The project accentuates this demand for the practical and demonstrable. By a proper extension of the term it includes several groups of big, constructive units of study in history and geography and science, and culminates in the masterpieces of literature and works of art, as poems, buildings, sculptures, and paintings, because these at their best are great designs worked out by artists to express the mind's boldest flights into the world of experience, the supreme purposes and projects that men have conceived.

The project, as such, is an apt device for teaching, because it touches off any important enterprise at its most interesting crisis, namely, at that juncture where it is in

the initial process of being brought into shape in the mind. Pedagogically, we might call this "the nick of time" in thinking out any enterprise. At this point it shows itself in its freshness and newness, its expectation, its purpose. Its growth from this initial stage should be natural and progressive. Let the project develop in its own way, revealing its ugly form or its pleasant aspect as it will. The succession of problems will follow in due order. The important project is always a problem and a mother of problems. The demand of the hour is to have a chance to think, to knit the brow in thought problems, to struggle with a difficult and critical situation till a solution of the problem is discovered. Live projects, wisely selected, not only set up serious problems, but they draw in their wake the knowledge materials required for the understanding and solution of the problems involved. Big projects are deeply rooted in the strong knowledge elements of the important studies. A deeper and richer scholarship inevitably clusters and organizes itself around the main projects. This is so because our modern social and industrial problems have sprung directly out of a full field of scientific, historical, and economic knowledge. These deep, abundant sources of knowledge are our necessary tools in working out our projects. Extensive and up-to-date knowledge is requisite to work out and understand these practical projects. One proof of this need for depth and richness of knowledge in discussing these projects is the fact that even trained experts in the various special lines are required in all these big, practical enterprises.

The project, a scheme in the making

We have been discussing the word *project* as denoting something objective and concrete. But back of this, its real meaning lies in an idea, in something thought out and

clearly conceived, first as a mental product, later to be worked over and transformed into a concrete reality. The synonyms of the word *project* are *scheme*, *plan*, *design*. In this sense the project is first of all a clear, clean-cut, intellectual grasp of a whole complex situation. It corresponds to the well-worked-out design of the architect which expresses the plan of a great building. The project is a strongly, wisely organized body of thought focused upon an important center of practical knowledge with a definite purpose. It is the intellectual formulation and mastery of a problematic situation as a preparation for its practical execution. It leads on through a series of wisely controlled actions. In the idea of the project lies also the impulse to realize it, to carry out the purpose clearly conceived, for example, the sinking of a shaft for the purpose of exploiting a coal bed. This demand for clear thinking as a basis for later action, leading on naturally to a complete accomplishment, makes the project an ideal basis for teaching and for lesson planning. The project sets up something clear and complete in thought but lacking in fulfillment. It sets up the demand for full realization, and this is a dynamic quality which energizes effort in the right direction.

The project, a mental concept to be realized

Standing out prominently, almost objectively, as a clearly thought plan to be converted into reality, the project contains the most important elements of a standard unit of mental effort. First, it is an important whole. Secondly, it is dynamic in its essential forward movement. Thirdly, it organizes and uses knowledge on the basis of a definite purpose. Fourthly, it sets up a series of problems requiring continuous, rational effort. Fifthly, it works out a practical result which is embodied

Standard elements in a project

in a concrete object or situation in real life. Sixthly, as an end result of the whole movement, from original conception to final objective realization, it leaves in the mind a knowledge product which serves to introduce and explain other kindred projects. It has a future as well as a past and connects up between the two. Thus it contributes to the continuous organization of knowledge.

Important projects, therefore, carefully selected in the various studies, are the practical units of thought, the organizing centers, where knowledge is collected and incorporated into those powerful agencies which carry on the world's business. Thinking out and understanding these projects puts the student into the stream of action, into the current of life. We demand that education be a preparation for life, but it can be this only by identifying itself with the main enterprises going on in life, that is, with enterprises which have developed under life conditions. Many of these enterprises are now active agencies, organizing and directing the social and industrial forces of the world. Others have grown up in the past and have created institutions which are still powerful as life centers. Still others are mainly historical, but carry important lessons to us from past experience. The building and equipment of a monastery in medieval times was in those days a vital, living project. Hannibal's march across the Alps to attack Rome was a well-matured project. Hercules' scheme for cleansing the Augean stables was a true project in the modern sense. Joseph's far-sighted scheme for dealing with the wheat crop of Egypt during the seven full years was a great project.

School projects express and interpret life

But it is the projects of modern life and society that most concern us. In the short period of school life children

should be led on till they gain insight, one after another, into the masterful projects that concern the progress and welfare of the people in their struggles to master the bountiful resources of nature. Such schemes concretely worked out form naturally the big centers of study. They designate the main channels along which human life has organized its experiences and converted them into institutions through which men have been able to accomplish their purposes. These very projects, already organized by experience into complete schemes and processes for accomplishing the chief purposes of life, are the best units of study for the schools.

Nor are these projects new or foreign to our present school course. A keener and closer inspection of these project-topics will discover that they deal with the self-same concepts which are now treated in the textbooks. But only the more significant subjects dealt with in the books are selected, and by intensive treatment brought into marked prominence. They are given an emphasis and a fullness of descriptive exposition which are surprising. They are not new, and yet one thing in them is strangely new. They are dressed up in their proper clothing. We do not recognize them at first because we never before saw them in full equipment and with an adequate setting. For example, the increase of corn production in the United States, the project of developing San Francisco harbor, the building up and life history of Mount Shasta, the purpose of Ernest in the story of the *Great Stone Face*, how the blood circulates and performs its functions, the laying out of the school and home garden, a class at work dramatizing the story of William Tell, the designing and construction of a bird house.

Projects are a stronger handling of textbook topics

These and many more like them are not new topics. They are simply familiar topics enlarged into proper units of purposeful effort. They are fully embodied and demonstrated life problems. They are suggested and put before children in this more complete form to stimulate thought, to put the minds of children into natural, spontaneous action toward worthy ends.

Conclusion.

Projects reorganize the best knowledge materials of the elementary school around practical life centers. The smaller projects of children grow into the greater projects of the community and of society. These projects develop everywhere through series of problems undertaken with set purpose to realize important ends. The teaching possibilities that open up through the steady schoolroom pursuit of these developing projects are both interesting and remarkable.

A Forecast

If the project is once accepted as the true type of knowledge organized for teaching uses, it sets up the *large unit of study* as a basis for selecting and treating school subjects.

The *big unit of study* is a superior substitute for the present somewhat miscellaneous collections. It is the clear demonstration of a reconstructive principle which is now at work rebuilding our courses of study and reorganizing our classroom instruction.

We have already gone to the limit of filling up our curriculum with all kinds of information and with many forms of activity. We have been so busy collecting these varied materials that we have not yet had time and strength

to simplify and organize. The *big, central unit* of growing knowledge, the *project*, is the sure corrective to our present fragmentary accumulations of knowledge.

The adoption of such *large standard units of organized knowledge* points directly toward a simplified course of study and to a sound basis for lesson planning.

A second point of almost equal importance is the outstanding objective character of the project. It is never abstract and general. It is incurably objective. Teachers and textbooks drift almost invariably into abstract forms. But the acceptance of the project strikes the death blow at this prevailing tendency toward abstract method in teaching.

The following chapters will elaborate the above-mentioned points.

CHAPTER II

EXAMPLES OF COMPLETE PROJECTS

A BETTER understanding of the meaning and scope of these school projects may be gained from complete illustrations. This chapter is given over to such illustrations. Several projects are here worked out tentatively as suitable for school use. In the later chapters other projects are introduced to illustrate special points and are developed on a still larger scale. Many other school projects have been more or less elaborately worked out as monographs and are published in pamphlet or book form. In the following chapters frequent use is made (by reference) of these attempts to put projects into the form of complete units of study. The project type of organization, as exhibited in these illustrations, helps to clear up the principles of method as directly applied to subject matter in teaching.

GARDEN PROJECTS

The planning of a school or home garden is a project which has come into vogue in many schools and in all parts of the country. The garden work, planned for a season, is not only a practical project, but it develops into a whole series of minor projects which spring out of individual or family needs. The following table of contents gives the series of topics treated in a pamphlet entitled "The School

and Home Garden."[1] Without premeditated effort to emphasize the project idea, it evidently consists of a series of projects carried out in the natural order of development. The initial project, the measuring and staking out of the garden plot, is clearly shown by the chart on the following page. One of the minor projects is shown in the sketch of the hotbed.

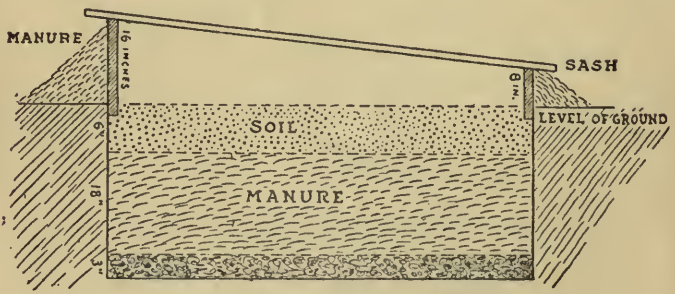
PROGRESS HILL SCHOOL GARDEN

TABLE OF CONTENTS

1. Introduction.
2. Making a Garden Survey.
3. Planning the Garden.
4. Laying Off the Garden.
5. Preparation of the Soil for Planting.
6. Laying Off the Individual Plots.
7. Making the Garden Paths.
8. Selecting the Garden Vegetables.
9. Study of Succession Crop Chart.
10. Frost Data for Georgia.
11. Testing Seeds for Weeds and Vitality.
12. Planting the Garden.
13. Keeping the Garden Calendar.
14. Germination.
15. Making the Cold Frame.
16. Making the Hotbed.
17. Cultivating the Garden.
18. Thinning and Transplanting.
19. A Study of Soils.
20. Studying Legumes as Fertilizers.
21. The Home Garden.
22. Plan for a Home Garden.
23. Plan for Home Project Work in Gardening.

[1] "The School and Home Garden," by Miss Sue C. Cleaton, in *Type Studies and Lesson Plans*, Peabody College, Nashville, Tenn.

24. Experimental Plots and Tests.
25. Studying Weeds.
26. Studying Diseases and Insects.
27. Birds.
28. Methods of Control of Insects and Diseases.
29. Resistant Varieties.
30. Sprays and Directions for Using Them.
31. Spray Calendar for Garden Diseases and Insects.
32. Coöperative Marketing.
33. Saving the Surplus.
34. Preparation of the Garden for the Summer Vacation.
35. Beautifying the School Grounds.
36. A Comparison of Garden Reports.
37. Report of Home Gardens.



Showing Construction of a Hotbed

List of a Few Home and Farm Projects

Concreting a basement floor; papering and decorating a family living room; building a tree house; making a tool chest; supplying the kitchen with running water; building and hanging a gate; constructing a corn crib; planning and laying a tile for drainage; planning and building a chicken house; putting in an asparagus bed; the construction of a fireplace and chimney; building a silo.

PLAN FOR SCHOOL GARDEN 60 × 50 FEET

16′	12′	12′	12′	16′
Experimental Plot	Cold Frame	Hotbed	Experimental Plot	

Walkway 3′

1¼′	12′	12′	12′	12′
2½′	Turnips			
2½′	Onions and Lettuce			
2½′	Cabbage			
2½′	Lettuce and Radishes			
2½′	Beets and Carrots			
1¼′	1	2	3	4 5
1¼′	Mustard			
	Onions and Lettuce			
	Cabbage			
	Lettuce and Radishes			
	Beets and Carrots			
1¼′	6	7	8	9 10
1¼′	Spinach			
	Collards			
	Kohl-rabi			
	Lettuce and Radishes			
	Beets and Carrots			
1¼′	11	12	13	14 15
1¼′	Kale			
	Rutabagas			
	Cauliflower			
	Lettuce and Radishes			
	Beets and Carrots			
1¼′	16	17	18	19 20

The City of Washington, a Project

The founding and building up of Washington as a capital city may be used as an example of a project which has been developing for more than a hundred years and is still in progress.

After Congress had decided that the new capital should be located at some point on the Potomac, George Washington was authorized to select a site and lay out the preliminary plans. Washington cherished the idea that the new city should be conceived as a grand project destined to grow into a magnificent capital. He had a large conception of the future of our country, and the new capital city was to correspond to this idea in its development.

Washington chose for his adviser in planning the city an eminent French engineer, L'Enfant, who had served in the Revolution, and explained to him his great conception of the coming city. Jefferson had collected in Europe a number of carefully drawn plans of European cities and these were sent to L'Enfant for his study.

After a careful survey of the present site of Washington, then an open farming country, L'Enfant projected a grand city plan for the street system, including the chief locations for public buildings and squares. The streets were very broad, from 80 to 160 feet, meeting at right angles north and south, east and west. To give variety to this plan, at two central points in the city, circles or squares were established from which broad avenues radiated in all directions, intersecting the other streets. The Capitol square and that on which the White House stands form such centers for street radiation, and these centers themselves are connected by broad avenues.

An examination of the street system of Paris will reveal similar centers of organization for the street system. Washington thus may be said to be built in part upon a French plan.

The constitution of the United States, which fixes the framework of our government, may be said, also, to determine the two chief centers for the capital city. At least Washington has two focal points in its organization as a federal capital, namely the Capitol Building and the White House, which are about a mile and a quarter apart and are connected by the broad Pennsylvania Avenue. The third department of government, namely, the judiciary, does not figure prominently in the architecture and street system of the city. The reason for this may be worth looking into.

For many years after its first beginnings the city of Washington failed to live up to these grand expectations. It was a big city only in name and on paper. Its streets were muddy and its few public buildings were far apart. Its straggling houses sprawled out over a vast area and it was long known, in a joking way, as the city of magnificent distances. It was not unlike the United States itself during that early period, consisting in large part of vast unexplored and undeveloped regions. As a capital city Washington was as yet an unrealized project. And yet the nation was growing rapidly and Washington soon began to show signs of a corresponding growth.

The best way to understand Washington, therefore, is first to examine the large-minded, prophetic plan under which it started out, the early halting steps at progress, and the occasional relapses. In the early part of the nineteenth century and again after the Civil War, the early,

comprehensive plan of the city seems to have been overlooked or disregarded, and a few great federal buildings were wrongly designed and placed, as the Treasury Building, and the great State, War, and Navy Building. In later years came stronger and more successful efforts to work out the great original design. In fact the development of the governmental departments in Washington reflects in a striking way the main stages in the rapid progress of our country in the first century and a quarter of its growth.

The main building in Washington, and we may say the chief structure of its kind for the entire nation, is the great Capitol, with its massive dome dominating the scenery of Washington. It stands upon an eminence nearly a hundred feet above the Potomac. The cornerstone of this great building was laid by George Washington in 1793. It was then in an open country, now in the midst of a great city. The central structure, now only a part of the whole, was large enough to serve for both houses of Congress till the Civil War period. The old Senate Chamber is now the Supreme Court Room, the original House of Representatives is now the Hall of Statuary. The two vast wings of the Capitol, later built, contain at present the Senate Chamber and the House of Representatives.

As the nation expanded westward and new states were added, the legislative department of the government had to expand to meet the larger needs. Not only so, but this large Capitol is now flanked on the north and south by two noble architectural structures, the Senate Office Building and the House Office Building, for the special service of Congress. They contain six hundred rooms for the use of members of Congress as offices for the transaction of

legislative business and are completely equipped for these purposes.

Across the park that fronts the Capitol is the magnificent Library of Congress, a constant reminder to members of Congress that if they lack knowledge and wisdom with which to serve their country, here is the place to find it. In this beautiful and stately building are extensive collections of the most valuable books and reports, well arranged and easily accessible. Here members of Congress and other officials may inform themselves on all important subjects so that they may legislate more wisely for a great nation. Copies of all books published in this country are sent to the Library of Congress, and other books from all nations and in all languages are gathered here and made available. This national library has a capacity for 4,500,000 volumes. The marble halls and interior decorations of this building are beautiful beyond description and are deserving of prolonged visit and study.

Around this park fronting the main Capitol are thus grouped four great buildings devoted mainly to the business of lawmaking and for the convenience of the lawmakers. Their total cost was $25,000,000. At this center and in these buildings are gathered, when Congress is in session, the representatives from every state and district in the nation to make laws for the government of all the people in the states.

A mile and a quarter away, at the other end of Pennsylvania Avenue, the White House stands at the center of another group of national buildings, representing the administrative department of the government. The White House is first of all the home of the President, where he lives with his family. It is also his official residence as President.

Clustered about it, some nearer and some farther, is a group of department buildings where tens of thousands of clerks and officials are engaged in public affairs. Just east of the White House is the Treasury Building, and on the west the great State, War, and Navy Building. The cabinet ministers have their headquarters in these and other administrative buildings. With the growth of the business of the nation the cabinet has been enlarged from time to time by adding new departments and by extending the government service into new fields. The Post Office, for example, has extended and enlarged its service until it reaches every nook and corner of the land, and is now identified with the business interests and home life of all the people. The Patent Office, with its vast collection of scientific and practical inventions, expresses the progress of the nation in ten thousand ingenious ways. By the expansion of its various departments of government service, Washington has become a busy hive of workers in the state employ. In the recent emergency of a great war, demanding thousands of additional helpers, Washington could scarcely house and entertain the great influx of clerks, stenographers, and specialists urgently required. Visitors and leaders from all parts of the country also flocked to Washington on public and private business. Before the outbreak of the war, the city had grown to a population of 350,000, and now it is much greater. Instead of being scattered out over empty spaces, as once, the city is now well built with beautiful homes and avenues and is crowded to the limit. Baltimore and other neighboring cities must help take care of the overflow population.

George Washington, before a house was built, had a noble conception of a spacious and beautiful capital city which

would suit the character and needs of a great and ever expanding nation. The plan he adopted looked far into the future and contemplated a capital city worthy of America. The plan projected by L'Enfant and Washington has been in large measure adhered to, but in recent years a still greater conception of a capital city in harmony with modern ideas of art and architecture, of sanitation and municipal improvements, has come into view.

In order to project a plan on this more expanded scale, with due regard to the best architectural and artistic ideas, there was appointed in 1901 a commission of notable architects and artists who developed and reported to Congress a complete scheme of future improvement, using the old plan of L'Enfant and Washington as the basis. In the improvements more recently planned and now in process of execution the enlarged design of the commission has been followed.

In an article in the *National Geographic Magazine* for March, 1915, Ex-President Taft has set forth the advantages of this elaborate and complete plan for the development and beautification of the capital city. A full series of drawings and panoramic views of the projected improvements is worked out with colored charts. These plans are likely to be carried forward and will make Washington one of the most interesting and beautiful capital cities of the world. Noble, sanitary, artistic city planning is to-day one of the chief concerns of the people in all parts of our country. Washington should be a shining example of great city-building. It will be one of the great achievements of our time to make the capital city, Washington, a first-class illustration of architectural and sanitary street planning, of the artistic designing and grouping of public

buildings and parks, of beautiful and imposing historic monuments, of first-class management of public utilities such as lighting, water supply, and car service, of libraries and education, and of beautiful, homelike, residential streets.

This modernized, elaborate plan for the city-beautiful in Washington has for its central landmark the lofty Washington Monument. Along the axis of the Mall, stretching westward from the Capitol Building past the monument to the Lincoln Memorial on the bank of the Potomac, will be a great series of parks and public buildings. At right angles to this a similar series of parks and great structures will stretch from the White House and grounds past the Monument to the Potomac near the harbor. A great memorial bridge will reach across the Potomac from the Lincoln center to Arlington. This scheme contemplates an extensive series of parks, boulevards, and bridges stretching into the environs of Washington and reaching even to the Great Falls of the Potomac, twelve miles above the city. It is a magnificent dream of city improvement and decoration.

The history of the original planning of the city and the more than one hundred years of progress along the lines laid out by Washington form a great page in our national story, but the outlook to-day is for a far greater achievement, one perhaps that would astonish and delight even the prophetic eye of Washington. It will always be preeminently the city of George Washington, and yet Lincoln in the natural order has come to share on equal terms the honors of the national capital.

As the plans already outlined are carried into execution, Washington will become more and more a place of profound

interest and pride to all Americans. Every boy and girl should have a chance sooner or later to visit this city and should read and study our national history in its streets and monuments and public buildings, and should recall the great historic occasions that form the landmarks in its history.

The foregoing is little more than an outline for a study of Washington in its plan and growth and future. It should be reënforced by a careful examination of maps and photographs and may lead into special features connected with famous men and events in Washington.

Washington differs from all other cities in this country because of the complete dominance of the governmental idea. This also leads naturally to the study of public buildings and architecture, and likewise into biography and history.

Washington exhibits in a concrete form the chief phases of active government. When the city plan is thought of as a great project, growing and expanding with the increasing demands of government, it becomes an illuminating study of our national life. References for further study may be named as follows:

Washington Standard Guide.
National Geographic Magazine, Vol. 27, 1915.

A Boys' Project

THE OVERLAND TRIP TO CALIFORNIA IN '49

In the winter of 1848 John Turner and his brother, living near Chicago, decided to start for the gold fields of California in the following spring. They were under twenty years of age, but they were enthusiastic in studying maps

of the western country and in making preparations for the journey. At that time there were no railroads west of Chicago, and very few towns west of the Mississippi. A strongly built, covered wagon was secured, and, before starting, was well filled with the tools, clothing, provisions, camp equipment, guns and ammunition, saddles, harness, medicines, and trinkets that would be needed in the long trip across plains and mountains.

The Turner boys hired another young man to go with them, and, supplied with six horses, they started in March for the distant gold fields. In the journey across northern Illinois they toiled along muddy spring roads, and forded the streams, camping out at night. At Rock Island they were carried across the Mississippi on a steam ferryboat and started over the wild prairie and grasslands of Iowa. Other gold seekers were traveling in the same direction, and they did not lack company.

At Council Bluffs, on the Missouri, the boys halted for two weeks, and there joined a caravan of fifteen wagons and forty-two men for the trip across the plains of Nebraska. Having crossed the Missouri River, the long train of wagons and horses slowly followed the valley of the Platte River westward. Keeping close to the river they found plenty of water, wood for their camp fires, and grassy meadows where their horses could be picketed to graze of evenings and mornings. There was good hunting in the woods bordering the river. Crossing the river, occasionally on log rafts, they pushed on westward till they came to the buffalo country. Here the extra horses and rifles came into use. The boys left their man on the road to drive the heavy wagon, while they mounted horses and rode out upon the plains to chase and kill the buffalo.

At that time vast herds of buffalo wandered over these grassy plains, coming to the river to drink. At night the men all came together at the camp, and around the blazing camp fires cooked the choice parts of the buffalo and cracked open the thigh bones for the precious marrow.

After a week or two of this kind of sport, when the horses were tired out with chasing the buffalo and with hauling the heavy wagons, they halted at a grassy meadow, pitched their tents, and went into camp for two weeks. Bringing out their tools and a forge they repaired their wagons, reshod their horses, mended their harness and clothing, brought in the buffalo meat from the chase and cut it into long strips to be hung up and dried.

The Sioux Indians from the north at one time threatened their camp, but the pioneers quickly formed a barricade of their wagons, and the Indians, though strong in numbers, were afraid to attack the camp defended by more than forty good riflemen. The Indians rode off and were not seen again.

After two weeks of rest and refitting they broke camp and started for the mountains, still following the Platte along the North Fork into the foothills. Crossing the main ridge at South Pass, near where the Union Pacific Railroad was later built, they descended the dry, desert-like slopes of the mountains to the west, almost starving for water before they reached a branch of the Green River. From a high ridge four miles away they saw the sparkling waters of this stream and rushed down the slope and plunged, man and horse, into the stream, where they slaked their thirst. Pushing on through the mountains, they at last reached the small village of Salt Lake, founded a few years before by the Mormons. Here they rested

for two weeks from their hard journey across the mountains and prepared to cross the salt deserts beyond Salt Lake. This broad lake in the midst of the western mountains was a refreshing sight to the well-worn travelers. Frémont and his men had been the first to explore this lake about six years before in his famous pioneer trip across the mountains.

At Salt Lake the Turner boys joined themselves to another caravan of emigrants and all started across the deserts. It was a tedious march for men and animals, and when they reached the grasslands about the headwaters of the Humboldt River, all were tired out. Three men were selected to guard the camp and the rest at once fell asleep. But the guards, too, were weary, and were soon overcome with sleep. While the whole camp slumbered, the prowling, thieving Snake Indians from the north crept into camp, cut the ropes that held the mules and horses, and drove them all off. Some four hours later, when the men awoke, they found not a single animal, and the whole company was thus left in the wilderness, hundreds of miles from California, with their heavily loaded wagons but no animals. In this distress they selected six of their strongest men, who were sent in rapid pursuit of the Indians. Traveling day and night for three days they were unable to overtake the retreating Indians with the horses. But they chased them so fast that the Indians left behind a few of the less speedy mules, and the men returned with these to the camp.

The mules not being strong enough to haul the heavy wagons, pack saddles were made, and the most needful things were loaded upon the backs of the mules, and the whole party, leaving their wagons and goods in the wilder-

ness, journeyed on foot the rest of the way to California. They reached the foothills of the Sierra Nevada Mountains before the winter snows set in. A wagon road led up one of the valleys by a roundabout way across the mountains, but the men chose rather a foot path which led by a zigzag way directly over the mountains. Reaching the highest ridges they looked down into the Sacramento Valley in California, and then followed the American Fork down the mountain side till they came to the gold diggings.

The next year, in making a trip from the gold mines to San Francisco, Mr. Turner narrates that he noticed a man ahead of him in the road driving a wagon that looked familiar. On coming up with it he discovered that it was his own wagon, which he had left the year before on the other side of the mountains when the horses were stolen.

The Great Migration

The story of the Turner boys illustrates the experiences which many other gold seekers had this same year. During the summer of 1849 about forty thousand emigrants, men, women, and children, crossed the plains and mountains to California. Many of them suffered distressing hardships on the way from sickness and death, from lack of food, and from Indian attacks. A few of them came too late to cross the high mountain range before winter set in and were compelled to spend the winter on the east side of the Sierra Nevada, because the snow piles up on these mountain ridges twenty and even forty feet deep during the winter storms.

From New York and other Eastern States thousands

of people took ship for Panama and reached California after crossing the Isthmus and taking ship on the Pacific side for San Francisco. Many were taken sick with fever at Panama and died before the journey was finished. Still others went the long route by ship around Cape Horn and northward along the entire coast of South America to California. Other gold seekers came from foreign lands, for the gold excitement had reached all countries.

As a result of these various migrations nearly a hundred thousand people reached California during this first year of the gold excitement. The little adobe village of San Francisco grew in one year to a population of twenty thousand. At first there were many lawless men, who committed crimes and outrages, but the better class of sober people soon organized government and subdued the criminals and law-breakers.

These things happened just after the close of the Mexican War, before which California had belonged to Mexico. But before the end of 1849, the year of the great migration, the people of California had become so numerous that they came together, formed a constitution, and sent word to Washington that they would like to be admitted to the Union as a new state. This brought on an important crisis in the political affairs of the United States. California had no slaves and would naturally be admitted as a free state. But this did not please the people of the Southern States because they feared an increase in the number of free states. A fierce conflict was threatened between the North and the South. Henry Clay returned to Washington in his old age and succeeded in his last great compromise in quieting the storm, and California was admitted to the Union.

The rapid increase of population and wealth in California led the people to wish for a closer connection between the Eastern States and the Pacific Coast. In consequence the project of building a Pacific railroad was proposed in 1850, and every year from that time on the matter was taken up in Congress. But the North and South, between 1850 and 1860, could not agree where the railroad should be built. Finally a bill of Congress was signed by Lincoln as President, and the Union Pacific was begun, and after several years was completed in 1869.

The gold discoveries in California led not only to the settlement of California, but to the opening up of Oregon and Washington, so that a group of Pacific States was soon growing up which developed the resources of the whole Pacific Coast.

In 1859, ten years after the gold find in California, important gold discoveries were made in the Pikes Peak region of Colorado, and people flocked to this region as they had done before to the far West. Denver sprang up and became a flourishing city. Silver and gold mines were developed on a large scale, and the discoveries extended further north and south along the Rocky Mountains. The gold and silver production soon began to rival the wealth of California. Before long a group of Rocky Mountain States was developing toward statehood. These two important gold discoveries had a powerful influence upon the early and rapid settlement of the Great West, in the founding of cities and in the growth of two important groups of states which are now an influential part of our Union of States.

In later years rich copper ores were found at Butte, Montana, and gold in the Black Hills of Dakota. These

discoveries had results similar to those already described in the founding of cities and development of states.

The discovery of gold in Alaska at a still more recent date led to a rush of gold seekers to the frozen North. The hardships of the Klondike gold hunters were even greater than those of the forty-niners. As a result the remarkable resources of Alaska, not in gold alone, but in forests, coal lands, and fisheries, have been made known to the world. Lines of ships with extensive commerce have been established from Seattle and other western cities to Sitka, Nome, and other ports in Alaska.

A little reflection will convince us that these rapid movements of population westward at the time of the gold discoveries are only a striking part of the great westward movement of the American people which has now been in progress for three hundred years since the beginnings of Jamestown and Plymouth. Looking still further back, the movements of people which led to the settlement of the thirteen original colonies were from Europe — westward ho!

The above unit of study, which begins with the trip to California in '49, is a good illustration of these large, central projects. It exhibits a progressive thought development through two main stages. First, the full narrative of personal experience, which gives a rich descriptive background for all the later discussion; secondly, the steady growth and expansion of the topic to include the entire migration to California and the Pacific Coast, then to the Rocky Mountain States, to Alaska, and at the close a brief survey of the whole westward movement. Around the central idea of westward advance is grouped and organized in a natural order a large and important aggregate of historical

and geographical knowledge. Such a study begins in definite, interesting, personal experiences, develops into large state interests, and then expands into national importance. It finally gives a broad and significant survey of our whole history, even points back to great European migrations and becomes a world topic. Such a unit of study naturally grows into large proportions. It cannot be squeezed into the narrow limits of a twenty minutes class period. Our big topics demand time and space and rich materials with which to work their full influence.

Teachers in order to handle these big topics must study them thoroughly and master them completely.

The Muscle Shoals Project

At the Muscle Shoals on the Middle Tennessee River, the Government of the United States is now at work upon a national project which was held to be of vital importance to our country in time of war. At the Muscle Shoals is a long series of rapids where the whole volume of this broad river drops down 140 feet. Here is a natural water power which the Government has decided to make use of by building dams and an electric power station to produce nitrates for the manufacture of explosives.

The Congress of the United States passed a bill authorizing the president to select the site for this national plant and appropriated twenty million dollars for the work, later increased to sixty millions. This at once brought the Muscle Shoals district into much prominence. Up to this time the Muscle Shoals have been chiefly known to the world as an obstruction to steamboating and commerce on the Tennessee River. Several millions of dollars had

been spent in canals and locks to overcome these difficulties in navigation, but without much success.

Among all the important water powers found along American rivers, why should the Muscle Shoals be chosen at a time of pressing national danger as the one spot for establishing the government's largest hydro-electric power plant for the production of nitrates?

To find an answer to this question the President and his advisers had to deal with a series of important and interesting problems.

1. Is the power that can be generated at the Muscle Shoals great enough and can it be kept up steadily throughout the whole year so as to meet the full demands for such a plant? There are periods of flood in spring and of low water in summer, and the amount of power is quite variable during the four seasons. Here was a problem for expert engineers, who must study the record of the river and its tributaries for many previous years, to ascertain the facts. The government would require for the success of such a plant at least 120,000 horse power continuous throughout the year. As the result of their studies and figuring the engineers came to the conclusion that the river at the Muscle Shoals can furnish 250,000 steady horse power, and for the greater part of the year up to possibly 600,000 horse power. This makes it, next to Niagara, the largest single water power in the United States. The Muscle Shoals have the advantage also of being far enough to the South not to be obstructed with ice in the winter time. In order to secure the largest steady supply of water for the Muscle Shoals, it will be necessary also to build reservoirs in the upper tributaries and sources of the Tennessee River in the mountains. The extension and development

of forest reserves for holding back the storm waters will also help to regulate the flow of waters in the flood season.

2. But why is it necessary to have such a plant at all? What are the sources from which we have heretofore obtained our nitrates? Inquiry into this point brings out the fact that we have at present in the United States no source of supply for nitrates at all adequate for meeting the urgent demands of war. Nitrates have been shipped into the United States in large quantities from Chile, a far distant country. A hostile nation strong enough on the sea to cut off that supply could make us helpless in the midst of a great war. In order to be safe our country must have a supply at home large enough to meet all demands.

3. How can the water power at the Muscle Shoals produce these nitrates in sufficient quantity to satisfy our needs? A study of this question brings out the fact that we have plenty of nitrogen all about us in the atmosphere. The main question is how to get hold of it and put it to use. Scientific experts have discovered a method of doing this. By means of the electric current it is possible to draw nitrogen from the air and combine it with other substances to produce nitric acid. The nitrates thus formed can be used in making explosives. Such is the purpose of this hydro-electric power plant at the Muscle Shoals.

4. Another question to be answered is, What are the raw materials that combine with the nitrogen of the air to form usable nitrates? Are these substances found in the neighborhood of the Muscle Shoals? Limestone is known to be the chief of these raw materials and limestone is found at the Muscle Shoals in unlimited quantities.

Coking coal is also needed and that is obtained from the Tennessee Valley and at Birmingham not far distant.

5. One of the important considerations was to find a location for this plant where it would be safe from attack from all foreign enemies. It must be within what is known as "the safety zone" far from the seashore or from boundary lines of foreign countries, even beyond the reach of hostile airplanes. The government entered upon a survey of our various water powers from this point of view. Of all our large water powers on American rivers the Muscle Shoals were found to be best located with respect to foreign enemies.

6. What use could be made of such an expensive plant in time of peace? A study of this problem brings out the surprising fact that a nitrate-producing plant is quite as valuable in peace time as in war, because these nitrates, when combined with phosphates, form the best of all fertilizers for the enrichment of agricultural lands. The making of the fertilizers for restoring the productivity of worn-out lands is one of the most important problems in the United States to-day. In the cotton states of the South and along the Tennessee River there are millions of acres which need these fertilizers in order to maintain the productive power of the soil. Again, just north of the Muscle Shoals in Tennessee is an extensive deposit of phosphate beds which will supply this essential material.

It is to be noted also that a large hydro-electric plant like this at the Muscle Shoals supplies in time of peace a source of power for commercial and manufacturing purposes. This power can be carried on transmission lines to Memphis, Birmingham, Nashville, and other cities and towns within a radius of two hundred miles, and put to use for running

factories and street car lines, for lighting cities, and even for household uses. The agricultural and industrial wealth of a large as yet undeveloped region along the Tennessee River will be greatly increased by establishing this important plant.

7. What will be the effect of this power plant upon the navigation of the Tennessee River? The building of three dams at the Muscle Shoals, each of which is supplied with large modern locks for passing boats and barges up and down stream, will have the effect of completely removing all obstruction to navigation. The pools formed above the dams cover the shoals and make deep, safe water for the passage of boats. The Muscle Shoals Project, when completed, will open up the whole Tennessee River from the Ohio to above Knoxville to free navigation for large steamers and barges. With all obstructions removed, an extensive river commerce is likely to grow up and cities like Florence, Decatur, Chattanooga, and Knoxville will have the advantage of a cheap transport for heavy products like coal, lumber, iron, marble, grain, and other raw materials.

8. A natural water power put to service is a substitute for coal. It has been estimated that the full use of the water power at the Muscle Shoals will save one and one half million tons of coal in a single year. This coal, at $3 per ton, would be worth $4,500,000. The development and use of a great water power is thus a means of saving this amount of fuel. In other words, this is a plan for conserving the coal supply of our country for future uses. Engineers have estimated that we have about 60,000,000 of unused horse power along the rivers of the United States. When all these natural forces are put into use, supposing that

each horse power is the equivalent of three tons of coal a year, it would bring about an annual saving of 180,000,000 tons of coal. The labor, machinery, and expense of running the coal mines could then be largely spared and turned into other channels of production.

9. Why should the government rather than some rich private company undertake this project as was the case at Keokuk and at Niagara?

Congress has decided that the safety of the nation is dependent upon a full supply of nitrates to be used in the manufacture of explosives. The production of this supply of nitrates should be wholly under the control of government so that the full power of the nation can be used promptly in time of war. For this reason the Muscle Shoals plant will be built and managed entirely by the national government.

A proper study of the Muscle Shoals Project, and of the many problems connected with it, is merely a lively and instructive introduction to a much larger topic, namely, — the value to our nation of our unused water powers. In this connection there should be examined and studied a physical map of the United States upon which are located all these rivers with their valuable water powers. Among these are the rivers of the Southern Alleghenies, the Atlantic seaboard rivers, including those of New England, and the Mississippi River with its numerous tributaries. The Rocky Mountain and Pacific Coast streams will be found to furnish our largest resources for hydro-electric plants. The future wealth and power of the United States, the growth of its cities and population centers, the increase of its commerce and manufactures, and even its agriculture are largely dependent upon this one idea, the utilizing of the natural

but as yet unused water powers of our rivers. The Muscle Shoals Project with its interesting problems, fully presented and discussed, opens to a clear understanding one of the chief agencies for developing the resources of the United States. This power plant in a large way will contribute to the direct improvement of agriculture, of mining, of commerce, and of manufacturing. If we keep the Muscle Shoals Project clearly in mind it will throw light upon the more general discussion of projects which is to follow.

CHAPTER III

THE SIGNIFICANCE OF PROJECTS AS LARGE UNITS OF STUDY

The need of large study-units

THE emphasis given to projects in Chapter I is justified because these projects are big, commanding topics which deserve to hold an influential place in our school studies. In the necessary reorganization of our curriculum, the big projects, or what we may now call *large units of study*, are bound to hold the chief place. They are becoming more and more the centers of organization for knowledge materials. The thoughts and labors of both teachers and children are to be focalized strongly upon these main centers of knowledge. We need, therefore, to get a clear conception of these large units of study which are coming into such a commanding influence.

A big unit of study brings together and ties up in one bundle a large number of related facts forming a well-constructed whole. Otherwise these facts might remain disconnected and meaningless. In giving prominence to central units in instruction, we emphasize the larger grouping of related facts or organization around natural centers of thought. Again, this organization of facts or of knowledge materials into a unit is designed to give a setting to a single important idea which in turn is the principle of organization.

The big-unit conception applied to the curriculum as-

sumes that each main study such as history, science, literature, or geography is built up out of these large wholes or units of knowledge rather than out of individual facts. The separate facts are too small and fragmentary to serve as units of construction in knowledge building. Facts indeed we must have, and in spelling, primary reading, writing, arithmetic, that is, in what are known as formal studies, the mastery of individual facts counts for much. But we have been totally misled in supposing that the separate fact counts for much in history, science, literature, geography, or in any rich content subject. The enlargement and enrichment of our recent course of study compels us to abandon this itemized, bookkeeping style of knowledge and to focus our attention upon big projects as thought-centers around which the numerous facts are organized. The big-unit conception of knowledge assumes that each study is framed up out of large timbers or structural units. Knowledge is like a big plantation which is made up of large fields, but not of individual acre lots, or like our Federal Government which is combined out of large political units called states and not out of an endless multitude of small townships.

Facts to be collected about important centers

Such units of instruction are easily pointed out in all the important thought studies. The Declaration of Independence, for example, with the facts and consequences that properly group themselves around it, is such a focal basis for historical survey. The history and development of the steam engine is such a series of important stages or problems. In this progress it gathers into its own sphere of influence a large assemblage of historical events and of scientific data. It is still going

Examples of large units

on and will continue to be an organizing center of influence in human affairs. The building of the first Pacific railway, the discovery and exploitation of gold in California, Columbus' first voyage, stand out as natural, conspicuous beginnings and centers in historical progress. In applied science equally valuable centers appear, as the heart and circulation of the blood, the invention of the telegraph, the life history of a butterfly, soil fertility and its preservation in agriculture, Mt. Shasta as a volcano, yellow fever and the mosquito.

In the nature of the case, we are compelled to pay attention to individual facts, but only as they are sensibly grouped around these important thought-centers which are properly called teaching units. The recent expansion of our curriculum so as to encompass an ever increasing multitude of facts has forced us to enlarge our vision, to take in larger wholes, to group and organize facts into a few centers so as to bring them under the mind's control, in other words, to simplify and unify knowledge. As knowledge becomes more extensive we must search for fewer and stronger centers of organization.

Large units negatively defined

If we are to reorganize our method of classroom instruction on the basis of these big projects or knowledge units, omitting many minor topics and detached facts, it becomes necessary to determine, as clearly as possible, the character of these big units. What are the earmarks by which we can detect such a standard unit of study? Let us define a unit first negatively by telling what it is not. First: Such a unit is not a fact. A single fact standing alone is meaningless; a host of such facts may be equally meaningless. A group of facts properly organized and controlled by an idea may be

of the utmost value. Facts are important and necessary but only when properly combined and related. A lesson made up of isolated facts or of bare enumerations or lists of disconnected facts is too fragmentary. A single fact interpreted by its bearing on other facts and in its wider relations may grow into an important center of thought. But mere single facts or dates in history, the bare names of places on the map, are not important enough to be studied and learned. Facts that do not demonstrate the influence of organizing ideas fail to function. Examinations based on disconnected fact material are trivial in value, like picking over rubbish heaps. This desultory treatment of scattered facts is a waste of time and a training in the formation of bad habits.

Secondly: A unit of study is not a miscellaneous collection of even important facts. The mere naming or listing of facts on the assumption that they are important carries no meaning to a child. Some of our textbooks are padded with puddingstone collections of presumably important facts. Rational reflection rejects all such miscellaneous data as a clog upon right thinking. Every important subject of study should stand out as a well-ordered whole, not a shapeless, accidental heap of facts. Thorough and repeated drill on such lists of facts is an inferior if not wasted form of mental effort.

Thirdly: A unit of study is not identical with a lesson lasting twenty minutes — or forty minutes. A recitation period of twenty minutes is seldom just the amount of time required for the treatment of a real project, and yet not uncommonly teachers drop into a habit of considering recitation periods as equivalent to lesson units. Important units of subject matter usually require from four to a

dozen lesson periods for their proper treatment, often still more. A fixed time limit, such as the daily recitation period, appears to be a wrong standard of measure for the large unit of study. The entire process of thought in a complete unit of subject matter is the determining factor, and this is subject to wide variation, contingent on the ability of the class and the nature of the subject.

Fourthly: A proper unit of study is not a brief survey or outline of points for discussion. Such outlines may hardly serve as substitutes for knowledge. Unless the outline is accompanied with a parallel, full enlargement of each particular, it is disappointing. Teachers and children alike suffer in school studies from a lack of nourishment, that is, of abundant actual knowledge arranged with reference to leading points.

Presenting these mere outlines before teachers and children is like offering empty dishes to guests at a feast. It is cheap, easy work to supply outlines, but to furnish a well-arranged, fruitful collection of choice knowledge on a valuable subject is a noble gift. It is the result of painstaking, thoughtful effort and rich experience. In providing these fruitful, well-organized topics an opportunity is presented for performing a great service to teachers and children. It is astounding how few of our leading educators have thought it worth while to furnish teachers and children a varied and full diet of knowledge. Theories of teaching are likewise no substitute for full knowledge, for rich scholarship. It is easy also to offer excuses for not doing this: "Let the teacher learn to help himself," "Do not tell children what they can find out for themselves." What a makeshift argument! In traveling through a desert country it is refreshing to come upon wells

of water and fruitful gardens provided by those who have gone before. To supply poor, meager outlines for other people to fill out is a lazy man's job. It is a common way of shirking a hard task. Let the leaders in education go forward and show by example how to work out rich and fruitful topics. A few such big teaching units or projects completely organized out of interesting, instructive thought material suitable for children would do much to give us a sound basis for classroom work.

Fifthly: A unit of study is not a rule, or principle, or abstraction. At least this is not a suitable form in which to present it to children. In any case the abstract form should come later, when it is needed, as a natural outgrowth of the full treatment of the subject. It is deceptive and dangerous even to name by abstract titles big topics such as government, taxation, industry, or physiography, because teachers are so prone to fall back on a mere abstract phrase or definition as an adequate form of knowledge and wholly to neglect the sound basis of concrete teaching, *i.e.* full descriptive illustration and expansion of the unit.

Unless the enlarged descriptive content of a unit of study is worked out into a definitely presented, enriching body of knowledge, a lean outline and shallow teaching are inevitable. The teacher imposes upon the children the same hopeless burden of dull abstractions which has already been imposed upon the teachers. But the teacher has the same excuse, "Every child should think this out for himself." What a pity that the child has no one upon whom he may roll the burden of making bricks without straw, of trying to think clearly without a realistic knowledge basis for thought!

Turning to the positive side, what are the distinctive marks of a standard teaching project or unit of knowledge?

The positive side

First: It is knowledge stuff in which there is a central organizing idea. This generative idea is not only the focal center but it is the principle of organization in the development of the topic. Like the embryo in the seed it predetermines the nature and process of growth and the final result. The purposive idea is the living energy that shapes the big unit in its process of growth toward fullness and maturity. The architect's idea shapes the house. The idea of irrigation determines the process by which any big project of irrigation is worked out. The development of a distinct, unique character in fiction with its complete setting is a unit of study. Such a controlling idea, as a center around which a big topic organizes itself, is illustrated in history, — Washington's campaign against Yorktown, a real project; the first voyage of Columbus; in geography, the Erie Canal — all projects.

The basal idea

A proper unit of subject matter contains within itself a complete, energetic thought movement because the organizing principle of the topic is such a progressive, self-propelling, purposive idea and demands its own full cycle of growth. Give this idea free scope to demonstrate its organizing power, and a strong, complete, well-rounded unit of thought is the necessary result. Burke's speech on Conciliation has just such a simple organizing principle of thought. The building of the Panama Canal rests back upon such a constructive idea or purpose. A railroad system is projected and constructed upon the specific notion of the continuous transport of goods as a means of interchange between given regions. Ruskin's *King of the*

Golden River has a developing thread of thought which ties all its parts together into a complete story. The energetic, dynamic quality of the idea, combined with its constructive force in grouping and uniting thought elements, is what makes study a real achievement. Purposeful ideas are such dynamic forces at work in the world building up industries, shaping institutions, organizing and directing the business of life. Education consists in propagating these world-building ideas in the minds of children. Once planted in the fertile soil of receptive minds these ideas show their full growing energy, their organizing quality and strength. Genuine ideas are never static. Mere facts may become almost static memory products, but ideas keep on growing and gathering new materials around these old centers of thought. This growing, dynamic element in knowledge is its life-giving quality.

The strength of these large projects as vital ideas lies in the fact that they are present, growing, life organizations. Large mining, agricultural, and manufacturing processes, as big organized agencies for carrying on these operations, are the center and essence of these large teaching units. They are objective demonstrations on a large scale of local, national, and world processes in the industries. A big topic springs directly out of life, is rooted in life, and, when once understood, interprets life. One of these big subjects fully cleared up and demonstrated explains a long developing process in the past up to the present, and then clearly forecasts and interprets the future, *e.g.* a study of the lumber industry.

Secondly: A developing unit of study gathers to itself and embodies the full content of a rich, well-organized collection of knowledge. It is not a skeleton outline, but

is clothed with the flesh and tissues, as it were, of a living organism. It is rounded out with the full complement of concrete, illustrative information. In this particular of adequacy in treatment our textbook topics are very scant; they are not complete units of study and are not so regarded. They are so lean and unstable that they collapse like an empty sack for lack of content. The main thought lacks a background against which it can reveal itself in its full meaning.

A center for growth and organization

A good story or poem gives this embodied thought, this elaborate setting to the chief idea. In *Horatius at the Bridge* the spirited hero stands forth in the presence of both armies, the bridge and crowded walls of Rome on one side, and on the other the ranks of the Tuscan army with glittering war gear marching down from the northern hills. The whole setting is complete and cumulative. The *Christmas Carol* of Dickens gives a highly wrought description to exhibit the background and full biography of the growing Christmas spirit. The schoolmaster is beginning to learn the one great lesson taught in the works of first-class writers, to which there are no exceptions (from Homer to Kipling), that any idea worth presenting should have a complete, adequate, and even artistic setting, else it loses its force and degenerates into a poor, weak thing. It seems a thousand pities that the schoolmaster is sometimes slow to learn this lesson. He holds with a death grip to his logical outlines and condensations and abstractions.

Every big unit of study as a developing project requires ample scholarship, a real life setting, a complete environment for the idea. For teaching purposes we may give special emphasis to the objective or concrete character

of such units. The idea may be embodied in some person, as the idea of the Erie Canal in the person of De Witt Clinton, or in a striking object like the Brooklyn Bridge, or in some great natural landmark, such as Mt. Shasta, or in a natural agent, like a Rhone glacier; or it may center in an important practical project, as the power plant at Niagara or the building of the first Pacific railway, or the laying of the first Atlantic cable. Such topics are not bookish and school-made, but practical and life-made. It is through these pragmatic topics that the school is able to strip off its artificialities and become absorbed into the ongoing activities and interests of a real world. A big strong unit, like a well-loaded cannon, is one that is charged with a full measure of knowledge material.

Thirdly: This developing unit of subject matter, organized into a strong thought movement, an expanding project, is just one clear, complete, and convincing illustration of a hundred or a thousand similar movements. By means of a brief comparison with similar projects or processes this one illustration becomes the easily recognizable type of a whole class of kindred phenomena scattered up and down the earth. Explain fully the process by which the Rhone glacier is formed by accumulating snows upon the mountain slopes, and then, by pressure, consolidating and pushing its slow course down the winding valley, scouring the mountain sides and carrying the waste materials to lower levels where the ice melts away in the warmer sun, giving rise to the rivers, and you have described almost the exact process by which all mountain glaciers in all high regions of the world have been doing their gigantic work for centuries. To understand thoroughly the work of one glacier is to understand

The type

and interpret all glaciers. Describe one big steel mill at Pittsburgh as a business undertaking, with its blast furnace, converters, and rolling mill, giving the sources of its raw materials, and the use to which its finished products are put, and one will easily master the problem of steel production wherever carried on in this or in foreign lands. Study out the machines and processes of one cotton mill and you will understand cotton manufacture, though it be carried on in ten thousand factories the world over. Likewise woolen manufacture and other textile production will be easily understood on the same basis.

Wise people tell us that if we read and ponder well one great book, we shall understand the gist of many books. Fortunately for us the world is built on this basis of a few simple types. Master thoroughly a few of these essential and far-reaching types and the world of knowledge becomes tributary to our thought.

So far reaching is this interpretative significance of the type that teachers have been misled into substituting for it the definition, which is the purely abstract form of the typical idea. The definition or general statement does contain a truth that might explain clearly a thousand or a million objects or phenomena. But this brief definition or abstract form of truth, though it be firmly memorized, fails to furnish the child with insight into the basal meaning, and it fails still worse in giving power to use such a truth so that it can work over into habit. Teachers are constantly falling into this trap, both teachers and children being caught and held in these abstract formulæ. Out of such abstract definitions neither sound knowledge nor good habits can spring. The soil is too thin and poor to produce a good crop. In any subject the truth which

lies at the bottom must be concretely enriched and nourished and strongly organized in order to produce a fruitful crop of genuine knowledge.

The type or project study, properly developed and enriched, furnishes a sound, concrete basis upon which to build the structure of knowledge. In the effort to secure economy and efficiency in our methods of instruction we must keep in mind, first, the basal simplicity in knowledge, resting upon a few central ideas or types, and, secondly, the deep fertilizing elements of concrete experience that must be gathered around the roots and beginnings of every important topic of study.

The basal principle in each case is plain. It stands out in large, bold relief commanding wide influence. It has the strength of a giant for bringing together and organizing scientific, historical, or geographical material, and sometimes all of these combined, and this *whole*, big unit becomes a larger measuring unit with which to test and judge other similar values on a broad and expanding scale. For knowledge in a big unit grows richer in power and scope as it develops. It is this outstretching power of an idea to lay hold of extensive data, and to organize them into a simple perspective, interpreting the world down long avenues, which gives such a study-unit its final complete value.

A big teaching unit fully mastered in its facts, meaning, and relations becomes a clear and well-defined standard for measuring future units of similar character. This typical, interpretative quality is quickly discovered and set to work in big projects like the Erie Canal, the City of Washington, the historic Rhine River, or the influence of the Alps Mountains. Thoughtful measurements as to qualitative and quantitative rela-

A standard measuring unit

tions, as to similarities and contrasts, as to causes and effects, result in a still larger grouping and organization of knowledge. Such big units keep on growing, expanding, and organizing thought materials through the whole course of study. Thus are steadily and strongly built up the fundamental norms with which to measure and estimate values not only in school, but throughout later life.

Let such an idea spring up from a rich, productive soil of concrete knowledge and it will surely develop out of its small, local, concrete beginnings and through later comparisons into a full world-meaning. It is only those big ideas which grow into this larger importance that we care to deal with. This is a world-building process and expands steadily to the interpretation of larger and yet larger wholes. It does not stop with the end of the school. Such school effort is rooted in experience and develops through life processes, and so it goes right on. Such ideas are the life of nations through which they maintain and develop themselves. It is not too much to say that the elementary school is dealing in a live way with the fundamentals of social and industrial life. The study of a wheat farm in North Dakota grows easily into the great wheat belt of the Northwest with Minneapolis as its center, but before long it is measuring the wheat fields of Australia, of Argentina, of India, and of the Nile Valley and the ocean routes.

Fourthly: As this central idea takes root and develops naturally in a child's mind, it organizes his knowledge into a growing habit of thought. His mind takes on an expanding knowledge-structure which becomes his own method of thinking. It not only organizes a child's knowledge into habits, but it reënforces these habits with powerful interests in the further develop-

A growing habit of thought

ment of knowledge. In this manner a strong, genetic instruction may have a molding influence upon character as it develops. The succeeding chapters of this book will bring into view, one after another, the various important aspects of the *Large Unit of Study* as a growing project. It is the one fundamental concept in this book which we wish to bring to a clear and complete and explicit demonstration.

In closing this chapter we may note that we have been discussing only one of the three important aspects of these large developing projects or units of study. To show the far-reaching importance of the large standard unit we designate these three points as follows:

1. The large unit of study or project is the basis of our plans in this book for enriching classroom study. This is especially true in all the important thought studies and to a less degree in formal studies.

2. A proper choice and serial arrangement of these important study units is the basis for the organization of the course of study. The treatment of this point will require a separate volume.

3. In the training of teachers we fall back upon the large standard unit of study as the center of operations. If teachers can learn to organize knowledge into such units, if they can master such topics before going into their classes, and can later carry out such well-planned instruction in the classroom, they will rapidly develop into efficient teachers. To deal properly with this phase of the large unit as related to teacher-training will also require a separate volume.

Summary of the Main Features in a Central Unit of Study

1. It has in it a basal idea, a center for the grouping of facts. Like a magnet it draws all things to one point. The story of Peter Cooper with his one great idea illustrates this.

2. The unit of study has in it a developing process of thought which is its principle of growth. In this is a dynamic energy that keeps it active and constructive, like the design of a building in the mind of an architect. The process of smelting iron ore and of making steel products at Pittsburgh is an example.

3. Such a topic is concrete. Its idea is embodied in some object, or person, or process, like a machine or manufacturing plant; like some great power plant, at Niagara Falls; or the projecting and building of the first steamboat.

4. The purposive idea as it develops gathers to itself an instructive and valuable body of knowledge which it organizes into its own structure. Like a growing tree, it assimilates into its own tissues the materials it needs. Example, the Panama Canal.

5. Such a large unit of study centers in some practical project like the building of a railroad or the laying of an ocean cable. It is not bookish and school-made, but practical and life-made.

6. This life project, when worked out, is found to be the key and interpretation to a large number of similar undertakings. It is a clear type and demonstration of an entire class of important projects, scattered up and down the whole earth. It is a vitalized rule or principle. Example, the steam engine, a canal lock.

7. Let this idea grow and it will develop out of its small, local, concrete beginnings into a national importance. It is a world-building process and expands steadily to the interpretation of larger and yet larger wholes. Example, A Wheat Farm in North Dakota, The Trip to California in '49, The Harbor of New York.

8. As this central idea takes root and develops naturally in a child's mind, it organizes his knowledge into a growing habit of thought. His mind takes on an expanding knowledge-structure which becomes his own method of thinking and of interpreting the world.

CHAPTER IV

THE ENLARGED OBJECT LESSON OR PROJECT AND ITS RELATION TO THE LEARNING PROCESS

THE project well worked out is simply a big object lesson in the process of learning — a demonstration of the right method of collecting, organizing, and mastering knowledge. It might be called an explanation of the natural learning process. In executing a real project, a child almost loses sight of the fact that he is gaining knowledge. He is mainly absorbed in reaching results. As an active voluntary agent he has his eye fixed on the end to be reached. Struggling to achieve this purpose, he finds himself in the midst of a world of knowledge waiting to be put to use. The best way to acquire knowledge is to get after some important aim which compels us to learn what is necessary as a means of reaching this aim. Teachers have been groping about for a long time trying to discover this natural process in learning. On this plan, enterprising young men with little schooling have educated themselves very successfully, — youths like Edison, Horace Greeley, Peter Cooper, and Benjamin Franklin. But it requires an unusual degree of originality and force of character to travel this road alone and unguided. The teacher can do much for average boys and girls by the suggestion of right aims and by occasional wise guidance in selecting and pursuing their projects.

A search for the natural process in learning

Young people have an instinct reaching after the important things in life, but they often choose unwisely. They require guidance toward the better kinds of experience and wisdom. At the basis of our human experiences are certain fundamental truths which must be understood and put to use. It has been the business of philosophers and advanced scholars to find out these truths, and to organize them into a system of knowledge which we call science. At first glance there seems to be a wide separation between this wisdom of philosophers and thinkers and the child's needs, at least as he sees them. It is the business of teachers to make this connection, to direct boys and girls in their own efforts to discover and master these world-truths and to identify their own interests and projects with them. To bring about this live connection between the child's interests and the world activities has been the great difficulty and even stumbling block in education. The projects which we have been discussing seem to furnish the middle ground where the child, absorbed in his narrow personal and social interests, can still begin to take on the larger purposes of society and thus appropriate the accumulated wisdom of this larger world. The basal truths of human life are often best revealed to children concretely in the working out of projects. For the project, developed through its important stages in a true life setting, is a first-class demonstration of the growth of an important idea or truth. In our educational theory this is known as the inductive-deductive process of reaching important concepts or general notions.

The transition from child experience to world-knowledge or science

The growth of ideas, by which percepts develop into concepts, reveals the basis of the learning process. Think-

ers and teachers have long been interested in the question as to how general notions are formed, whether they develop step by step from the observation and comparison of examples, or whether there is a shorter cut in thinking by which concepts may be reached. This matter touches the relation of induction to deduction in the thinking process and involves both in a close partnership.

The basis of the learning process

For practical purposes we may describe two theories regarding the learning process. First: Among teachers and school texts a long prevailing practice gives emphasis to general statements or concepts as a starting point in the treatment of important topics. For example, a recent primary geography describes *climate* thus: "The word *climate* means the usual state of the air, whether hot or cold, dry or rainy, windy or calm." A book in English composition begins with this sentence: "Composition, from the word *con*, meaning together, and *ponere*, to place, signifies a grouping or arrangement of materials, generally with a definite end in view." A textbook in physical geography begins a chapter on glaciers with the sentence, "A glacier is an accumulation of snow, for the most part solidified into ice, which is engaged in a slow movement from one place to another." Such definitions, at the beginning of a subject, are not uncommon, but still more common are general comprehensive statements covering important topics in a condensed, summary fashion. A primary geography has this statement, "Iron, copper, gold, silver, lead, and zinc are metals. They come from rocks. The rocks having metals in them are called ores. We find iron ore, copper ore, and lead ore. Gold is often found pure in nature."

Two theories

The first begins with generalities

Such brief, general statements make up a large share of the content of our elementary textbooks, especially for the beginning middle grades. Such an introductory statement on the first approach to any important topic is general and schematic, not definite and particular. In the introduction to history lessons, for example, topics dealing with the Puritans, with taxation, with state sovereignty, and with the constitution are mentioned briefly in general terms with little explanation, but with the expectation that these same topics will be dealt with more explicitly and fully in the later grades and in larger books. In the early study of such subjects children are not expected to comprehend fully and clearly what they learn. They memorize many statements not plainly understood in the hope that the future, out of its richer reserves, will make good this thought deficiency. Learning is a process of slow and gradual clearing up of concepts, beginning with statements vague and presumptive and gradually enlarging upon these at some later period with fuller resources of knowledge. It is the prevailing notion of putting off to a later time the day of clear and definite knowledge. It is the idea of a long twilight zone during the early approaches to knowledge. This emphasis of conceptual or abstract knowledge in the early stages of learning is a favorite notion among adults and especially among teachers and textbook writers in their attitude toward children. It has also in its favor a long tradition of method and practice in the schools.

A twilight zone

The second theory touching the process of learning is the opposite of the foregoing. Knowledge should start with the concrete, the sensuous, the vivid. The first im-

pressions on any subject should be registered in a child's mind in clear and vivid pictures, in a strong and intensive grasp of particular objects or situations, in ideas keenly felt and objectively demonstrated. While a quick, general survey of a situation may be allowed at the start, the emphasis falls upon the immediately following enlarged and descriptive treatment of the topic, upon a full life picture such as an artist would produce.

The beginnings in the concrete

In support of the second view, it is claimed that children at this early stage are not prepared for broad, general surveys of large domains in knowledge, that is, for a mere framework to be held in memory until a fuller knowledge at some future time can be fitted into it. Children should fill in the frame at once with concrete picturing. They require forthwith an objective, intensive, and experimental acquaintance with the subject. The school should see to it that the early ideas gained by children are clear rather than vague, specific rather than general, intensive rather than neutral, keen and vital rather than pale and shadowy. The first time a good topic is touched upon in early years, it should strike a vital point and ring out in the child's mind with a clear and sharp meaning. Children have no time to waste on vague and empty phrases. In geography the description of a cotton plantation should not be condensed into a bare sentence but should expand into a vivid and realistic picture of plantation life. Just as a choice fairy tale or myth centers in a live character (Cinderella or Siegfried) who engages in strong or startling actions, so a history story should cleave to the exploits of a notable person, as John Paul Jones, or Robert Fulton, or William Penn.

Mere outlines not suitable for children

The main argument for dipping down deep into concrete reality in a new subject, at its first appearance, may be stated as follows: It produces a keen, sharp mental reaction and leaves a deep and permanent impression. Future progress, also, in knowledge depends chiefly upon this quality of concreteness and vital force. Knowledge which lacks this sharp sensory element is vague and dubious, and has little power for the assimilation of new subjects. Children demand a kind of knowledge that will function as a prompt, interpretative factor in the close-following studies. Dull and vague concepts have little power to interpret later subjects. Dry and stupid memory processes do not make children keen and aggressive in interpreting new situations, but the contrary. Nobody can work to advantage with dull tools, and these vague general notions are the dullest of all dull tools. If the early ideas children get are obscure and foggy, they are discouraging and unsatisfying in themselves and they serve no useful purpose in explaining new problems. It is just as well that they are easily forgotten. At the very start, therefore, children should get a keen sensory experience and build up strong, apperceptive thought-centers, which become active power stations generating an onward movement into knowledge. Vivid object lessons should be the gateway to every new subject.

Sharp tools instead of dull tools

Which of these theories should take the lead in instruction? The first, the idea that children at first grasp the chief concepts vaguely, in broad general terms, and that these concepts are only gradually cleared up and strengthened, or the second, the opposite principle that a clearly intelligible basis for an idea grounded upon objective reality is demanded at the first, and a full under-

A choice offered

standing within these narrow limits secured? The first theory has had a long and powerful influence in shaping courses of study and in guiding methods of teaching, and an immense amount of actual instruction has developed upon this basis. The question that now arises is this, — Is it economical and efficient?

Historical survey

If we should take time for an historical survey of principles and methods in teaching, we should be convinced that the first crude impulse of educators in nearly all cases has been to begin instruction with important general notions or concepts. At the present time, also, our textbooks show a preponderating tendency of the same sort — general notions first, and a gradual clearing up of these general notions through later instruction. The history of schools and of methods in the past gives us plenty of evidence on this point. Religious education, the first to be taken up seriously, was based on the catechism, a brief summary of the most important religious doctrines. There is now, however, a strong tendency among progressive religious teachers to introduce for early religious instruction the stories of the Old and New Testament, to emphasize the historical books in preference to the doctrinal, at least in all early teaching, and also to make use of the biographies of religious leaders, missionaries, and benefactors of recent times as examples. The catechism, if used at all, would then come at the end as the culmination of this plan of progressive religious education. In other words, there has grown up in recent times a strong tendency to reverse the old order of religious instruction, and to introduce such teaching with stories and biographies, with striking impersonations of ideas, and to bring in much later the abstract and doctrinal statements of religious truth.

Religion

The study of literature in schools and colleges was formerly, and is still in some cases, a general description of the character and works of great writers, but not an early study of the masterpieces themselves. In recent years we have almost abandoned these generalities, these broad character sketches, and we have allowed the children to read and enjoy, from the first, *Fairy Tales*, *Robinson Crusoe*, the *Arabian Nights*, the *Pilgrim's Progress*, the *Wonder Book*, the *Greek Heroes*, Scott's *Tales of a Grandfather*, the *King of the Golden River*, the *Lady of the Lake*, and a host of other stories and poems which are the living concrete expressions of good literature, as furnished directly by the masters themselves. We have said good-by to those summaries, once the staple of school courses, those inane introductions to good literature.

Literature

A generation ago technical grammar, the rules and principles of the English language, was commonly taught in the fourth and fifth grades (*e.g.* the eight parts of speech), but now we try to arouse children to a keen and practical interest in stories, in excursions, and in lively topics in nature study for composition. We are pushing formal grammar far ahead or even into the high school.

Grammar

Thirty years ago it was customary in some of the best schools to teach the principal concepts of mathematical geography in the fourth grade. Latitude, longitude, and earth motions, — these general notions were regarded as an introduction to later topics in advanced geography. Such topics, as general concepts, are now left over to the grammar and high schools. The primary geographies of that period dealt

Geography

with the broad, comprehensive phases of physical and climatic geography, of commerce, agriculture, and other large general topics. Since then a quite notable change has taken place in primary geographies in favor of a simpler, more concrete treatment of home topics. Home geography in its outdoor phases, — excursions and constructions, — is now strongly emphasized. The old order has been reversed.

History

The first books in United States history some years ago gave a condensed outline treatment of the leading periods and topics of the whole course of American development. An examination of our recent texts in history will show that some books have abandoned these historical generalities and have gone over almost entirely to a lively treatment of the heroes of biography: Columbus, John Smith, Daniel Boone, Champlain, Washington, and Fulton, that is, the personal, concrete phases of history. Even in grammar grades biography begins to play a very important part, as seen in the treatment given the lives of Samuel Adams, Franklin, Patrick Henry, Hamilton, Fulton, Webster, Henry Clay, or Lincoln. Our American history is now being rewritten in the interest of concrete, illustrative biography and narrative for the early years, and the schematic outlines for primary books are being tossed into the waste heap.

Science

Even studies in botany and zoölogy have abandoned the old definitions and general descriptions of classes, and are dealing with outdoor excursions in fields and woods, with the descriptive life story of particular plants and animals, and are devoted to school gardening in their practical home uses and needs. Theoretical abstractions are at a discount in teaching children.

Even in the early days of manual training, teachers and children in shops were dealing with the general principles of construction as worked out in typical joints and modes of putting materials together, giving emphasis to the main phases of technique. Now boys and girls are working in shops to produce useful, practical objects, as tables and stools, bookshelves and houses, while girls in domestic arts make dresses and prepare meals. Children in the grades now begin with practical, everyday, useful problems and projects, not with principles of technical construction, not with mere technique and tool practice.

Manual arts

In these various ways progressive teachers have been demonstrating the importance of objective, practical beginnings in all subjects and the unwisdom of imposing broad surveys and generalities upon children in their early studies.

This later tendency toward the early emphasis of objective, concrete modes of instruction is in harmony with generally accepted principles of teaching as now presented in our schools and colleges. All of our pedagogical books and theories place a marked emphasis upon the sensory basis of knowledge in early years, upon object lessons and sensory training, upon variety and richness in motor experience, upon excursions, shop activities, games, and outdoor sports. The conviction is very strong among teachers and thinkers that the experimental basis of knowledge should be keen and strong and definite. But it is one thing to get certain principles generally accepted in theory, and quite another to put them into common practice. Barring exceptions, our textbooks and our school practice give the lie to our theories.

Which method is grounded in good theory?

In the first three grades of the primary school the principles of concrete, objective teaching are pretty generally adopted and worked over into effective practice. We have many excellent primary teachers who have mastered both the principles and the art of primary instruction, and their work is up to a good standard; not so in the intermediate and grammar grades. We are in specific need of good demonstrations of concrete teaching in middle and upper grades. Our theories are good enough, but our textbooks and usual practice do not correspond to these theories.

Primary schools good in plan and method

In the fourth grade for the first time we begin to use textbooks in the important knowledge subjects, and this brings us into trouble, into serious and permanent trouble. In the middle grades our primary textbooks slight the sensory basis of knowledge. They begin to condense and dogmatize and to impose the matured conclusions of adults upon young children. A famous teacher once replied to a student who was objecting to fresh, lively material not found in the textbook, saying: "Did you know that when knowledge is dead we put it into textbooks?" What an appalling proposition this is, if it is true! An attempt is made in some introductory books to remedy this fault by the use of pictures, sometimes in excessive quantity. Such pictures, while excellent, are inadequate to supply that fuller background of knowledge needed in an important topic. The increasing prevalence of supplementary readers in history, geography, and science is another strong proof of the general conviction that the textbooks are lacking in the richer, concrete elements of knowledge. The pictures and supplementary readers are a help and palliative of

Textbooks for intermediate grades are condensed and formal

temporary character, but they do not change the original textbook plan of abstract teaching for the course as a whole. The textbooks still remain largely condensed and abstract and it is difficult to find time, even if the illustrative materials were at hand, to enlarge and explain so many abbreviated statements. The texts give a summary treatment to numerous phases of geography, history, and science.

In spite of the improvements mentioned above, it is not expected that children will get a full and clear understanding of any topic on its first presentation, but a second or third larger and fuller treatment of the same topic will follow after two or three years. In this manner these first vague concepts are expected to develop into greater clearness. Beginning instruction still takes on a general schematic character, not tangible and objective. The illustrative method so characteristic of primary grades is reversed in the middle grades and a dogmatic, generalized instruction takes its place. A closer examination of the books and methods in common use in intermediate grades will bring to light this formal conceptual quality. It is a mark of the common tendency of the adult mind to impose its general conclusions upon children.

It is exactly at this intermediate stage of the school course that we need to return to a positive emphasis of concrete modes of teaching. This principle of concrete illustrative instruction, as noted before, has been successfully worked out and applied to the three primary grades. In the fourth, fifth, and sixth grades teachers generally have not employed illustrative methods with so large a degree of success. They have usually held more steadily to the books and to the usual routine of general statements to

A return to graphic methods in intermediate grades

be memorized and recited. Illustrative methods in the middle grades have not yet developed into a strong and consistent plan of teaching.

The middle grades open up a new world. In about the fourth grade we are entering for the first time upon important avenues of thought in history, in geography, in language and literature, and in science, which are destined to go on expanding to larger proportions through the grammar grades and much beyond. It is a matter of real concern how we make these beginnings. A child's first acquaintance with an important idea should be lively and realistic, not dull and formal. It should appear in a life setting with all the reënforcements of a concrete environment. This statement requires no argument, for thinkers on education are agreed as to the principle. The sensory basis of knowledge and the necessity for objective, tangible illustration as the introductory stage in all learning are acknowledged. Big, outstanding object lessons or projects, on a larger scale than heretofore, are required. By this is meant not a simple object as in primary grades, like a rock or tree, a yardstick or bushel measure, a house, or a picture, but a larger complex grouping of objects or persons or both into a life situation, as a sawmill at work, a house observed in its process of construction, the description of an exploit like that of William Tell in the apple shooting, the account of a journey across the mountains, as of Lewis and Clark, the building and launching of a ship. It is these large panoramic or bird's-eye views of life situations that should stand out as conspicuous centers of thought in these grades. Such complex panoramic views are built up and put together by a continued effort of constructive imagination

Panoramic views

based on description or narrative, with a free use of pictures, diagrams, maps, sketches, constructions, and other devices for objective illustration. At this juncture we may well exhaust all our resources in the effort to bring together and allow the children to collect descriptive and illustrative materials of the choicest kind and to combine them with artistic skill into a complete and well-ordered setting for a single commanding idea.

Having mastered the formal elements of reading, writing, spelling, and language in the primary grades, the children are now prepared to make a plunge into knowledge, — that is, into this big, real, active world, a world of significant facts, a world of growing, strengthening, purposeful ideas, a world where important forces are at work organizing facts into big, purposeful groupings or projects. These big projects we call by such titles as the following: a voyage of exploration, the founding and building of a city, the survey and construction of a railroad or canal, the discovery and use of a great invention, the printing of a metropolitan newspaper, the smelting and reduction of iron ores in blast furnaces and converters, the demonstration of mining projects and of large enterprises in agriculture; in science, huge physical phenomena as a cyclonic storm, the building up of a volcano by successive eruptions, or an ocean current at its work.

Big projects

In entering upon these larger thought-projects we cannot afford to blunt the keen edge of curious knowledge and blur these important ideas upon their first appearance by substituting vague abstractions. On the contrary we may use our utmost diligence to see that they at once awaken a keen intelligence and strike deep into a child's life and interest. The common practice

A false principle

of introducing children of the middle grades into the generalized, abstract forms of knowledge is the admission of a false principle of teaching which tends strongly to leave a long trail of confusion and even of disaster through the succeeding years of school life. The problem now is to bring our course of study and our practical teaching into conformity with well-understood principles.

The enlarged object lesson

When children in the middle grades meet with these projects, these big, practical groupings of life activities, they have a new and larger kind of object lesson with which to deal. The old conceptions of sensory training in primary grades, of object lessons, are wholly inadequate. The children are now to engage in making larger assemblages of facts and in grouping them into stable, objective units of thought. These big units are to be something new and distinctive in the child's progress. Both he and his teacher will have to gather up their forces for a new and stronger kind of effort in mental, constructive picturing, namely, the descriptive concreting of these big units to the child's thought. This is why we talk about *larger units of study* in intermediate grades. By this we mean not some broad concept which is abstract and formidable to the child's mind. Indeed we mean just the opposite of this — namely, something tangible and objective, something on a simple, big, corporeal scale, a grouping and organization of facts and forces into an outstanding, objective whole. These larger commanding thought structures at which we aim in the middle grades, we call *larger object lessons* or main *projects* as tangible units of study. The life of Columbus, for example, centered around his one great shaping idea and organized into a developing unit of effort, illustrates such a knowledge whole. It

projects itself also into the future, for his idea keeps on developing in the lives and exploits of other men, like Da Gama, Magellan, and later navigators. These projects grow still larger as we advance into the grammar grades. The planning and building of the Panama Canal is illustrative; the Salt River Project in irrigation, the growing harbor in New York City with its shipping, docks, and busy activities are further examples.

The teachers in the intermediate schools should be led into a new art of constructing and using these big units of study. It is not strange that our teachers in middle and grammar grades have not yet gained much skill in this fresh art of concreting and building up the larger object lessons. It requires an unusual abundance of fruitful, realistic knowledge and the art of putting together and building up these source materials into connected and well-compacted wholes. They have nowhere had much practice in this kind of study and organization. Besides, our leaders in educational thought have not yet taken the time and trouble to show us how to do this. They have been busy with other things and the task is not an easy one. This opens up at least a new and very important field of practical educational effort.

One reason for building up around these projects as centers such an elaborate and stable thought structure is that as big, tangible units of knowledge they are the appropriate and necessary beginnings of important thought movements to be continued through several years. They set in motion strong thought forces that are to go on growing and organizing the best knowledge materials in these grades as a necessary prelude for those which follow. We desire to get started right in our knowledge program at this critical

point. We wish to lay strong foundations upon which all the later structure of knowledge can rest. For this is a very decisive and critical point in the course of study. If we start with the wrong kind of topics and a wrong method in the third and fourth grades, it will have a depressing and almost fatal influence for several years if not for life.

A unique service for the middle grades

Teachers in the intermediate grades have a chance to perform a unique service for the whole plan and process of education by making the appropriate transition from the simple illustrative objects and devices of the primary grades to the larger constructive, objective interpretations revealed in these big, tangible projects and enterprises of intermediate grades. These large topics are the gateways through which the children may freely enter into the domain of world knowledge. Let them be beautiful and artistic in structure, at least not forbidding and discouraging. At this critical point, where children's minds should expand to take in large, tangible problems and dominant interests of the right sort, we may spoil the whole prospect for years to come by introducing vague, smooth-phrased concepts or deceptive general notions, and by imposing upon children a long series of dry, trite generalities. Unfortunately this is what we are really doing. Examine the textbooks and then go into the schools and see.

One important argument for big units of study in the middle grades is the advantage of massing effective knowledge at the strategic points, of concentrating the illustrative resources strongly and overwhelmingly at a few big centers of thought, so as to break through, as it were, into those big thought movements which shape and organize the course of study. If we can strike these spots hard

enough, we may gain an initial impulse, a headway in our thinking and organizing, that will carry us forward into the mastery of the controlling concepts of a world-building knowledge. This will enable us to master thoroughly a few main lines of thought. By this we mean the interpretation of the big projects and enterprises and institutions through which the important activities in the world are being carried on in history, in science, and in geography.

We wish to make these big object lessons of fourth and fifth grade more active and powerful in the interpretation of extensive knowledge reserves which the future has in store. The knowledge that children are accumulating from day to day, if properly organized and clarified, can be turned into apperceptive use far more effectively than has been the case. In order to gain this result we must see to it that our thought-movements through the grades are more simple, fundamental, and consecutive. We must first select those important centers which naturally hold sway over future developments. These centers and active interpreters of the world must ground themselves deeply in a genuine life setting, before they can start out upon their useful career. Each time, in taking up a new subject having in it such a strong and far-reaching idea, we should make a thorough job of it. We should lay the foundations deep and take plenty of time to bring together and group in proper relation all the facts and circumstantial data that exhibit this driving idea in its natural habitat, its full, real environment. Only thus can it function as a strong interpreter of later similar situations.

If we can once get started right in the middle grades with a well-arranged series of developing big object lessons suitable to the thinking powers of the children, we shall

take a long step toward establishing a wise and efficient practice in teaching.

This problem stands forth as a conspicuous landmark in the midst of our present educational endeavors and experiences. It marks the turning point in the present critical stage of our educational evolution.

Object lessons outside the school

The practical world outside of the school has been demonstrating a wise use of this big object lesson by giving it an influential place in carrying out important enterprises in the industrial, scientific, and practical world. For instance, a group of wealthy capitalists and of influential people was strongly interested in persuading the government of the United States to establish a large nitrate plant at the Muscle Shoals on the Tennessee River. In order to bring the whole matter prominently before Congress those interested employed an artist to paint an extensive panoramic picture of the Muscle Shoals district. The purpose was to bring the situation concretely before the Congressmen, to show the surpassing advantages of this site and its possibilities as a nitrate-producing station. By concrete demonstration, followed by full descriptive explanations, the matter was to be so clearly set forth as to convince the authorities and lead them to action. When people desire to get results in practical life, they use convincing arguments in the form of pictures and concrete demonstration. This is usually done in the case of adults who might be regarded as beyond the need of what are called kindergarten methods.

Again, at the San Francisco Exposition the different counties in California and other western states, wishing to attract settlers and investors into those districts, set up

a series of striking pictures and object lessons. A fruit district in Oregon, for example, presented a series of moving pictures illustrating the local fruit-growing industry, the clearing and preparation of the land, the planting and spraying of orchards, the irrigation ditches at work, the loaded orchard trees, the gathering and marketing of fruit, the thrifty homes and fine schools, the social life of the people, the mountain scenery and other local attractions. A lecturer, of fluent speech and marvelous statistics of production, explained and further elaborated the subjects suggested in the pictures. The purpose, of course, was to present an attractive and convincing picture of the advantages of buying a fruit farm and of settling in this part of the country.

The Exposition

At the Exposition quite a number of such small audience rooms were devoted to these attractive picture shows and descriptive lectures. They were remarkably striking exhibits of the resources of the western and mountain states. Indeed the whole Exposition, in its numerous phases, was a collection of beautiful and wonderful object lessons. One of those which attracted much notice was a complete miniature representation of the Panama Canal in which the Gatun Dam, the locks and lake, the Culebra Cut and harbor entrances, were reproduced and clearly shown in their tropical environment. Iowa, as the chief corn state, had a corn palace built up out of the ears of corn and decorated with the yellow and other grains. Corn production in its most interesting and useful aspects was exhibited in curious and artistic ways. The school children of San Francisco were regularly taken upon visits to the Exposition in classes, and were thus able to get the benefit of this remarkable series of object lessons.

Special demonstrations

It would be difficult to conceive of better demonstrations of such lessons for children if they were properly reproduced and discussed later in the schoolroom. The International Harvester Company has taken advantage of this same idea of objectifying its great productive enterprise. It gives in public places before schools a series of pictures of the wheat industry accompanied by an instructive lecture upon the wheat fields, the planting and harvesting scenes, the mills and shipments, and the choice loaf of bread as a symbol and result of this world process. It is a gigantic object lesson which exhibits to the onlooker and listener the meaning that lies behind this vast production and incidentally advertises these important interests to the world of consumers. It doubtless pays, for this kind of instruction is strong and effective.

The entire succession of national expositions of recent times, beginning with Philadelphia in 1876 and ending with San Francisco in 1915, has been a series of vast object lessons on an imposing scale, and producing important and far-reaching results. They have exerted a powerful and stimulating influence upon agriculture, mining, manufacturing, architecture, education, electrical invention, machinery, transportation, and other great human interests.

This method of enforcing truth by means of big object lessons is in vogue among practical men everywhere in a wide variety of situations. In the agricultural experiment stations of our state colleges and universities, field demonstrations are given in full detail. Corn and wheat, cotton and tobacco, fruits and vegetables are dealt with as problems under field conditions of soil and sunlight and moisture. Long ago Benjamin Franklin showed his astuteness by this method.

Object lessons at universities

Franklin had been trying in his published paper to persuade the farmers about Philadelphia to fertilize their lands with lime or plaster of Paris. They failed at first to respond, so he selected a prominent field by the main road leading into Philadelphia, and after spreading on the fertilizer he sowed wheat in prepared furrows and strips so that when the wheat came up the farmers could read in large green letters: "This field has been plastered."

It is worth suggesting that we have printed in big letters on every textbook page devoted to the dull, abstract treatment of topics: "These pages need to be plastered with descriptive illustrations." Many of our books need to be reconstructed on this plan.

A cotton plantation as an object lesson

The Department of Agriculture in Washington publishes a pamphlet, No. 364, entitled "A Profitable Cotton Farm." It begins with a description of a cotton plantation of less than a hundred acres which had been worn out by long cultivation without rotation of crops or replenishing the waste till it no longer paid for the labor of cultivation. Then follows a full descriptive account, with maps, diagrams, and illustrations, of a successful effort to restore the soil fertility and build up this farm again to a strong paying basis. By deeper plowing, by using rock fertilizers and manures, by rotation of crops and careful cultivation, by wise seed selection, by raising stock and feeding, by prudent marketing and by careful, scientific attention to business, this became a very profitable farm investment. The plan was worked out during a series of years, and exact accounts were kept of the outlay for labor, for fertilizers, for buildings, for stock, for houses and machinery, and for seed. Likewise the returns for grain, hay, and stock sold were

matter of record. This was a full, objective, practical demonstration, under usual farm conditions, of what can be done and ought to be done on scores and hundreds of such farms.

The agricultural and engineering departments of our state universities are showing us a practical pedagogy based on objective demonstration in field and forest, in garden and orchard, in dairying, in stock and poultry raising, in bee culture, in road and bridge building, and in many other lines of practical life.

This concrete method of demonstration is a proper combination of the scientific with the practical and strangely enough has been developed and has proved the best method for educating *adults*, outside of the school. In practical life when we undertake to convince others of the value of important projects in mines and factories, in industries and important schemes on land and sea, we invariably use big, concrete object lessons which set forth the facts and processes and results with unmistakable clearness. This is a kind of pedagogy which the world outside of the school has tried and found effective to produce results. And yet in the schools, with young children having little or no experience, we undertake the teaching of these very same subjects, as commerce, mining, agriculture, and government, without any, or at least without adequate, illustration. We as school teachers should go out into the world and take lessons of practical farmers, business men, and promoters of large enterprises in order to learn effective modes of instruction.

A pedagogy that works in the business world

The attempt to instruct children at the very beginning of such topics by using condensed and abstract statements

as the principal basis for knowledge is a curious and unaccountable misfit in education. An equally curious misfit is an occasional effort to impose upon young teachers unapplied pedagogical generalities, for it accustoms them at the start to a false method of thinking and of teaching.

CHAPTER V

THREE IMPORTANT PRINCIPLES PUT TO WORK UNDER RIGHT CONDITIONS

THE enlarged object lesson of the preceding chapter furnishes a fitting and profitable introduction to knowledge in different fields. But it is far more than a pleasant introduction. It has in it also a constructive principle upon which to develop a plan of teaching. The enlarged object lesson, worked out as a developing type, is only another name for the complete teaching unit or knowledge-whole, which is the basis of classroom method. The first step in the improvement of our methods is to furnish such strong, well-organized teaching units, which are the proper natural embodiment of right teaching principles. Until our course of study is made up of such selected and developed knowledge units, our teachers are at a loss what to do and the principles of teaching do not find appropriate material to work upon.

The first requirement a large teaching whole

The three principles mainly dealt with in the present chapter have been matters of long discussion among teachers and writers and are now clearly understood. How to turn them into active use and make them effective in school lessons is the main concern. On the basis of the enlarged object lesson or teaching unit worked out to its final results, we shall now attempt a dis-

Three familiar principles

cussion of three principles. The first is the process of combining inductive and deductive thinking in the development of essential truths. The second is apperception or the interpretative use of acquired knowledge as a means of assimilating new and kindred topics. The third is self-activity in the independent and reflective use of knowledge in solving new problems and in organizing the field of knowledge progressively.

The inductive-deductive process

First, in the elaborate treatment of our large teaching units or type studies, such as the *Virginia Plantation* in history, we magnify the principal stages of the inductive-deductive thought-movement. To begin with, the concrete, descriptive stage is greatly enlarged by a full exposition of the striking features of a single tobacco plantation. Following this a series of comparisons with other plantations in the cotton, rice, and sugar-producing states is presented till the plantation idea has reached its full scope. Finally, the application of this southern idea to other regions and to the whole industrial, social, and political life of the time is made. In such topics we find the main aspects of inductive-deductive teaching strongly stressed. Instead of a curtailment of these phases, there is an expansion and almost dramatic staging of the main steps. When children are dealing with important and sometimes difficult subjects for the first time, such dramatic exhibition is needed. The extended and elaborate treatment of topics is peculiarly appropriate to the mental needs of beginners.

A type study, such as the *Salt River Project* in irrigation, expanded into a complete monograph, maps out on a big scale (of miles rather than inches) the processes of induction and deduction. For example, the comparisons of the

Salt River Project with the Rio Grande Project at Elephant Butte stand out with conspicuous features. These might be called object lessons in the thought processes.

In contrast to this the more or less prevalent plan in the introductory texts used in middle grades of presenting condensed or abstract statements to children, as a beginning treatment of important topics, is a direct and flagrant violation of sound inductive teaching, and is an equally wrong method of using deduction. The fact that general truths are easy and intelligible to teachers as the matured results of long study and experience is no excuse. These definitions or condensed summaries are vague and difficult and disappointing to children. They put an artificial obstruction in the pathway of the child's thinking. They almost blindfold the child at the start. The rank deductive method cancels the natural process by which conclusions are reached, makes the child's learning needlessly obscure and difficult, and robs him of a keen insight into meanings and values.

A flagrant violation of these principles

This dogmatic and arbitrary imposition of unsupported conclusions upon a child's mind not only corrupts the sources of knowledge but it also blocks the way to a proper development of the same topics in their later stages. Knowledge should be a continuous advancement of main courses of thought through a developing series of kindred topics, for example, a series of kindred types in canal projects. This progress gives the proper interplay between inductive and deductive modes of thinking. Ideas, like trees, should grow and expand from year to year. But if the young tree is mutilated or stunted in its early growth, its later proper development is spoiled. It is of the first importance

The enlarged object lesson the first stage

to start out right in the intermediate grades with the strong, healthy, full growth of a few main ideas which may expand later to their natural, mature meaning. The enlarged object lesson, built up upon sensory materials with the aid of the constructive imagination, as a first full, concrete expression of an important organizing idea, furnishes the first stage of successful inductive-deductive teaching. It is the appropriate measuring unit upon which we can size up and standardize later knowledge materials and modes of instruction in this part of the course. The deductive process in the development of thought is just as essential as the inductive, and there is a constant interplay between the two. The mistake so often made in teaching is that of forcing abstract thought too early, before the concrete illustrations have been clearly given, upon which, as a basis, a safe deductive application can be made to other cases. This premature effort at both inductive and deductive thinking leads to those misfortunes which are sure to follow when we adopt the too common practice of early dogmatizing and of dictating to children the main concepts as ready-made conclusions for their acceptance.

Secondly, the principle of apperception is a sharp test of the working value of knowledge, of its real utility. To apperceive a new subject is to apply old knowledge to its right interpretation. A totally new subject like the Chinese language, which has in it no familiar elements, is extremely difficult to learn because it finds no points of contact in our previous knowledge, nothing to hook on to. French, on the contrary, to one familiar with English and Latin, is easy because so many words are similar in form and meaning to the English and Latin. One of the chief economies in education is to see to it that the

Apperception

mind is early and richly stored with those types of knowledge that interpret or apperceive on a broad scale. This is the clear and express embodiment of a potent idea, a real type, for example, the *First Steamboat on the Ohio.* This idea thoroughly understood is ready to serve as a keen interpretative factor in a multitude of future important navigation problems. The whole purpose of such a large object lesson is to set forth one single idea in a clear light, with its full surroundings and in its whole meaning. There is nothing vague or uncertain about the steamboat idea because the meaning is brought out unmistakably by a full, concrete setting. By comparing this idea of steam power on rivers in its concrete manifestation with other similar situations on lakes and oceans, the child's thinking becomes quick and flexible in applying its purport to a variety of life conditions. Thus the apperceptive power of an idea grows steadily stronger and keener. This intensive treatment of a single important idea, its concrete enlargement and its sharp illumination from every point of view, turning it into use in a variety of ways, until it grows into a ready habit of interpreting new situations — all this is a marked emphasis of the practical-use side of knowledge. This is precisely what is meant by apperception. The first steamboat idea, developed into a full understanding of the great era of steamboat navigation on the Mississippi and western rivers, has a wide-reaching interpretative value. It quickly explains the growth of lake traffic. It expands to the meaning of seaboard and ocean trade and develops step by step into a world idea which is even now opening up into a still greater future for world trade.

Progressive assimilation and use of knowledge

The extreme value of this principle and of this method in building up early a body of keen, active knowledge which will be serviceable in later studies cannot be overestimated. In this fundamental apperceptive process of organizing knowledge we find out that a few basal ideas embodied in strong object lessons are the organizers of a course of study, and they continue to develop and grow stronger as apperceiving centers through the whole curriculum. By setting up these strong, conspicuous object lessons early, on a large scale for the middle grades, we are laying the sure foundations for a stable knowledge structure and for a rapid advance in similar future studies. Having thoroughly mastered a group of these strong, practical ideas in the middle grades, the children are prepared to move rapidly to the conquest of new but kindred lessons. The grammar grades will simply offer a further development of these same ideas expanding under new conditions.

Continuous organization

This essential continuity of thought, beginning strongly in big topics in the middle grades, is marked in history. It is seen in the four hundred years of westward expansion, illustrated by the *Trip to California in '49*, in the strengthening principle of self-government, typified first in the town meeting, in the expansion of the representative system; in the improvement and extension of commercial routes, in short, in all the big topics, like slavery, emigration, tariff legislation, and the growth of cities. *The Purchase of Louisiana*, as a type study, shows in one conspicuous illustration the active principle of westward expansion which then interprets a whole chain of very important similar events running through our national history for three hundred years.

Continuity in history

The thorough mastery of one stage in the growth of such

a history topic furnishes the apperceptive material for a rapid, conquering advance through earlier and later stages. The fact that our history studies have failed to show up clearly this natural, sequential development of ideas is proof adequate of the blighting effect of a dogmatic, abbreviated mode of teaching. This latter method starts out with vague, blurred ideas and depends mainly upon a rigid memory process of learning dictated, somewhat detached, statements. This arbitrary process results in a collection of facts and stereotyped sentences of a fixed and static quality. They stand alone, sufficient unto themselves, finding too little relation to what precedes and follows. Flexibility and continuity of developing thought in an apperceiving process, with ready adjustment to new situations, are not the earmarks of this one-sided mode of study. Purely deductive, dictated teaching is not an assimilative, building-up process.

In like manner, big topics elaborately treated in the fourth-grade geography center around a few constructive ideas which will carry their interpreting value strongly into all the later studies. The complete clearing up of these fundamental ideas through forcible object lessons at the beginning is a wise precaution. Such topics, for example, as a sawmill and lumbering at Minneapolis, a cotton plantation in Georgia, the Hudson River, an orange grove in Florida, the harbor of San Francisco, the power plant at Niagara, a coal mine in Illinois, a salmon fishery in Puget Sound, the construction of jetties at the mouth of the Mississippi, — these topics strongly developed become keen and swift interpreters of scores of kindred lessons later in the course. This concrete enrichment and full clarification of fundamental ideas at the

Examples

start is the wisest economy in the whole teaching process. It is the very essence of usefulness in knowledge because it puts the whole stress upon that kind of knowledge which comes at once and perpetually into use as a keen interpretative factor.

The abstract, formal method in this important respect is misleading and fraudulent because it lays the emphasis upon a kind of knowledge that will not work, that proves helpless in the pinch of practical use. **Abortive knowledge** It is now well known that knowledge gained by such methods is weak and useless in power to interpret new subjects. This is all too natural because such general truths, unsupported by facts and illustrations, are vague and indefinite in meaning and cannot explain themselves, to say nothing of explaining other things. They certainly fail to unravel new and complex situations. In grammar, for example, it has been demonstrated many times over that a memory knowledge of bare rules and principles does not prevent mistakes in the use of common English; not that there is anything wrong in rules and principles, but because knowledge in this abstract form is vague and unreliable when demanded for use. The principle of apperception is extremely practical and exacting in its demands and it rejects as useless and false the vague, generalized knowledge that will not function in school needs or in later life's needs. Knowledge, on the other hand, that is developed clearly out of living examples and is constantly reënforced by quick reference to facts of experience conforms fully to the sound principle of apperception.

Let it be remembered that there is no longer a reasonable doubt of the correctness and supreme value of this principle of apperception. Knowledge that will not act as

apperceptive material in progressive learning is at an absolute discount. We are discovering that a large amount of this kind of knowledge, so called, has been stored up in children's minds as useless junk. To get rid of this waste and dead wood in study, and to put the attentive effort of children upon that kind and quality of knowledge that will function most effectually in learning new lessons is our present main business.

Emphasis on usable knowledge

Thirdly, another principle of prime importance, and now generally accepted as such, is that of self-activity. It has been much talked of in theory, but is very elusive in practice. It is the idea that children are to show a free, self-active, and self-determining spirit in studies. The big, expanded object lesson is a potent device for getting children started right into freedom, independence, and largeness of thought. It is copious in its realistic and illustrative materials. It seeks to come at a topic expectantly, picturesquely, and with full appreciation, to survey it in its manifold relations, to balance it up on this side and that. It holds to a focal center and yet reaches out in several directions into fruitful inquiries. Properly elaborated, it goes down into the roots of the main subject getting at basal facts and relations. It involves problems and brings to light whole series of problems.

Self-activity

Many of the big topics or type-studies are projects, pure and simple, that is, practical enterprises, worked out as problems under strenuous life conditions. Every step in the execution of a great project like the Panama Canal is an intense and vital problem, which can be placed before children as such, and their best mental effort can be thrown into the solution of these

Vital problems

problems. For example, What were the chief purposes in building the Gatun Dam, and how must it be built to accomplish these purposes? How could a hydro-electric power plant be built at Gatun Spillway, and where could it be put to use in the Canal Zone? The big topics not only present these problems clearly, but they also supply the facts and data upon which, as a basis, the children are enabled to think out a solution.

Such big, intensive object lessons are rich in thought and set the minds of children into free and liberal action toward important, self-determining efforts. This has been fully demonstrated in such topics as the planning and working of a gold mine in Colorado, the building of the Hoosac Tunnel, the Robin Hood stories, the construction and voyage of the first steamboat on the Ohio, the overland journey to California in '49, the problem story of Damon and Pythias, equipping for a summer camping season in the mountains. It is a strong stimulus to children in their early years to furnish them a chance to reach down deep into the roots of a few important problem studies. They gain the privilege of collecting around central ideas the full complement of pertinent knowledge. They arrange significant facts upon a strong central problem whose solution reaches out to interpret life in many directions.

The big project a gateway to freedom and self-activity

The barren, single facts, the algebraic generalities with which our primary school texts are sometimes cluttered, give a surprisingly narrow limit to a child's thinking. They lack stimulus and free scope. They cramp and hinder spontaneous movement in what might be a rich, growing field of thought. Freedom to think out problems is impossible within such narrow boundaries, just as freedom

and flexibility of speech are denied to one who is narrowly limited in vocabulary. The first important factor in the stimulation of a child's own thought is valuable, realistic, and copious knowledge, centering upon some important project. The second stage is furnished by a further natural expansion of these worthy topics into still larger and richer fields of thought. These extensions are found in the big, later, kindred topics of the upper grades. The mind grows in power with what it feeds on and assimilates. There is no place in education where rich and abundant information centering at a few points is more appreciated and more significant than in these middle and grammar grades, where wide-awake children are getting their first full supply of palatable mental food. At this critical stage we can afford to surprise the children with a few strengthening drafts at the full fountain of realistic knowledge. For once in their lives, and that early, they should experience the unstinted bounty of a few overflowing subjects of study.

How can these things come to pass in a plan of instruction based upon narrow, dogmatic thought processes with a shallow and meager content? The setting and solution of problems in projects is the standard form of self-activity. But at the start, the dogmatic process gives us the antidote for all this problem-work by foretelling the conclusion of the whole matter. The premature solution of every problem is given. It anticipates and precludes the thinking process which should lead up to this conclusion. It bars out self-activity in thinking and calls for docile memory performance. To awaken self-activity in children, we must give them more to think about, a wide range of valu-

Narrow, dogmatic processes hinder self-activity

able facts and ideas, and greater freedom in a full field of knowledge. A predetermined, cut-and-dried process of learning which leads to certain dictated formulæ forbids self-activity. But the natural full growth of purposeful ideas leads to a dynamic expansion of thought which must take its own course and is not always predictable. This growth points to a profitable evolution of thought into new phases, allowing a free mind opportunity to blaze its own pioneer way.

The principle of self-activity would imply that the entire self and the real self is brought into full action. In complete self-activity the whole force of one's nature is appealed to and set in motion in untrammeled, spontaneous effort. When properly directed upon worthy projects, this complete exertion of the self is the highest kind of training and of living. Two main elements of this kind of self-activity have been strongly emphasized in our recent educational discussions, — interest and effort.

Interest is the ready, delighted response of the soul to those phenomena or experiences in nature and in human life which appeal to it as valuable and worthy. They hold our interest and attention as valuable in their own right. Voluntary effort is the impulse of the soul to express itself and maintain itself, to subdue and appropriate the forces about it and make them subject to the self. It is the struggle to gain the ends of life against opposition and difficulty. Interest in projects and achievements measures and determines their values, and effort seeks to realize these values, to bring them into full possession.

Interest and effort

Accordingly the objects and undertakings one is strongly and permanently interested in are the expression of one's real character. On this basis, also, the things one is deter-

mined to gain and to hold by effort are the expression of strength and unity of life.

In laying out a plan of instruction, we should provide for a full measure of this self-activity grounded upon a strong union of interest with voluntary effort. To satisfy these conditions we must have a course of study full of valuable knowledge and abounding in true projects which appeal to the self as worth while. Every subject broached should be like the opening up and exploitation of a gold mine. It should challenge the self to the strongest reaction for self-realization. The type-study projects are selected and organized into practical units of knowledge which are designed to combine these best elements of strength. They really grow out of life situations and circumstances as necessary problems which challenge the thinker to his best reflective and constructive effort.

The type-study projects already worked out as tentative efforts to realize this purpose may be fairly judged on the basis of these principles. The *Salt River Project*, the *Virginia Plantation*, the *Peter Cooper* story, the *Panama Canal*, and the *Muscle Shoals Project* are definite efforts to organize suitable knowledge for regular classroom use. Our conclusion is that these three principles — induction, apperception, and self-activity — fail to function in all subjects which exhibit a feeble and shallow knowledge. There are three kinds of so-called knowledge in which these three principles find no footing, no ground on which to work, (1) vague and abstract knowledge, (2) miscellaneous or unorganized knowledge, (3) mere static, catalogued material. Unfortunately these are the prevailing forms of knowledge found in many of our textbooks, notably in intermediate and grammar grades.

Before we can get these three principles into use we must change the knowledge diet offered to the children. We must organize abundant, concrete knowledge around a few developing, purposive thought-centers. We must gather together the intensive, vital experiences that give a genuine enrichment and adequate unfolding to every real project that is brought before the attention of children. This conclusion is so simple and evident that we would be ashamed to state it were it not so constantly overlooked and neglected.

References

In the Series of Type Studies and Lesson Plans published at George Peabody College the following are given in pamphlet form:

The Salt River Project.
The Virginia Plantation.
Peter Cooper and George Peabody.
The Panama Canal.
The Muscle Shoals.

CHAPTER VI

A GROWING TENDENCY TO ADOPT LARGE PROJECTS AS STUDY UNITS

Illustrated by the Erie Canal Project

Among students and teachers there seems to be a growing tendency to select from each study a few big teaching units, to emphasize these as centers for the organization of knowledge, and to neglect minor subjects and mere facts. We are engaged in a knowledge-sifting process, a reflective weighing of relative values, for the purpose of discovering the things of chief importance.

This tendency to centralize and enrich instruction at a few main points is showing itself in a variety of ways. For a period of twenty or thirty years, in teaching reading and literature in the grades, the minds of teachers have been converging more and more upon a few of the longer classics as chief centers of study, for example, *The Courtship of Miles Standish*, *Robinson Crusoe*, *The Merchant of Venice*, *Rip Van Winkle*, *The King of the Golden River*, *The Great Stone Face*, Dickens's *Christmas Carol*, *The Pied Piper of Hamelin*, *Treasure Island*, etc. Each of these is an elaborately developed whole, an enriched and standard unit of thought, a project. Properly taught, it produces a cumulative, impressive educational influence. The *Christmas Carol* is read through as a whole and develops into a series of lessons enforcing a central idea.

Literary wholes as centers of study

In literature, therefore, teachers have formed the habit of centering attention upon important literary wholes, spending a month or even a whole term upon the elaborate study of a single poem or story. Around this piece they then group other kindred stories and poems, leading to a still stronger comprehensive organization of knowledge materials. Instead of fragments of poems and choice extracts we select a simple poem like the *Building of the Ship*, and the main idea elaborated in this becomes the focal center upon which to group other poems and prose selections, such as *My Captain*, *The Star-Spangled Banner*, Webster's Speeches on the Union, and the Lincoln Inaugurals.

The master minds in literature everywhere show this marked propensity to gather together and frame up their thoughts into these units of constructive art, which we call masterpieces and even projects. Teachers are waking to the discovery that in these finished products of great minds are revealed also the masterpieces of the best teaching art; because master minds, working at their best, instinctively hit upon the choicest mode of developing, organizing, and expressing great thoughts. All important thought studies should reap the benefit of this discovery, namely, that classic stories and poems are the best models we have of big, well-organized units of study. The literature we use in schools deals only with noble themes. Other studies should deal with nothing less than big thoughts. The minor, fragmentary, inconsequential facts and trivialities of knowledge should be banished from the school. In every study there are a few life centers and they should be found out and made the most of.

Literature supplies the masterpieces of the teaching art

The opposite extremes to the ideal forms of literature are the realistic products of the manual arts. They are also large units of thought. They, too, now stand out as complete units of construction, not as bits and fragments as formerly. The objects constructed now by children in the shops are complete projects or units of effort, requiring a well-thought-out series of mental and physical activities, extending through days and weeks of continuous effort and ending in a complete, finished, and serviceable project; such objects, for example, as a table, a chair, a bird house, a complete woven fabric, or a bound volume. Not many such products can be wrought out by each child. In the process of thinking out a complete design of a table, for example, and in the later careful execution of the constructive processes, a boy has carried through his thought and motor effort to a complete achievement. These well-thought-out and well-executed projects may be called, in a limited sense, masterpieces of design and construction. Such finished units of construction are objective demonstrations of the big unit idea in studies.

Complete units of construction in the manual arts

The household arts, also, and the school and home garden (not to say agriculture), are demonstrating to the world the value of complete enterprises, entire projects, as a sound basis for school exercises. (See Chapter I.)

The report of the Committee of Eight of the National Historical Society on the course of study in elementary history is a pronounced effort to reduce the number of topics for each year, to omit minor facts and statements, and to gain time for a fuller treatment of main topics. This report stands out as a landmark in the improvement of history instruction.

The Committee of Eight on history

There is also a growing and powerful tendency to apply the big-unit idea to geography study. Outstanding geographical types are set forth with descriptive fullness, as, the *Mississippi River*, the *Building of the Union Pacific Railroad*, the *Panama Canal*, the *Steel Industry at Pittsburgh*, *Niagara Falls*, the *Sahara Desert*, the *Growth of Chicago*, *Shipbuilding at Glasgow*, the *Gulf Stream*, the *Alps*, etc. We are now beginning to see clearly that these are big, objective units, wide-reaching in their organizing relations and world-extensive in their typical qualities. The confused complex of geographical information is cleared up and simplified by a proper exhibit of these big units of study.

Projects in geography

In nature study and applied science big units or type studies are coming into vogue, for example, the respiratory system, the life history of the thousand-year pine, planning the school and home garden, growth of the corn plant, Mt. Shasta in its growth and decadence, a forest reserve and forest conservation, the history and uses of the steam engine. Such topics have a broad scope and a world-building importance.

Types in science

In these various fundamental thought studies appropriate names have come into use which express the outstanding importance of such large units of study. In literature the term *masterpiece* is applied to a story or poem. In geography we speak of *physiographic* types, as a desert, or plateau, or river valley, or glacier. We deal with striking phenomena, as a cyclonic storm, or an earthquake or flood. In commercial geography we describe big *projects*, such as canals and railroad systems, or huge manufacturing and industrial plants. In history it is the biography of a great man, the rebuilding of

Terms used to express large units

a city, a military campaign, the founding of a state, the growth of an institution, or some invention or far-reaching discovery in sanitation that is dealt with. In English studies a *theme* for composition is a basis for gathering and organizing knowledge materials. In all these cases the mind seeks to grasp a whole, to organize simply great masses of knowledge framed up into big, dominant concepts. This is the child's and the student's simple method of escaping from confusion and chaos and of building up an orderly world.

An examination of more recent textbooks in geography and history proves that authors have begun to grasp this idea of large units of study. Many recent texts exhibit a tendency to select the big topics and to give them an enlarged treatment. This is plainly a reaction against one of the striking faults of schoolbooks, namely, a short, condensed treatment of many topics. Sometimes a mere sentence or short paragraph attempts to express the meaning of some large concept and that in language so general and abstract as to be almost meaningless. A radical change has begun and it will hardly stop before the course of study and the textbooks have been transformed in the interest of an enlarged and enriched treatment of a few main topics.

The transition from small to large units has begun

A good illustration of this change toward greater respect for big units of study may be cited in the treatment of the *Erie Canal*. By comparing a succession of history textbooks published during the last thirty years we find either the omission of this topic or its very brief treatment in the earlier books, and in notable contrast to this a gradually enlarging discussion of this subject in later books.

The Erie Canal illustrates this change

Out of a dozen history texts examined, four of the earlier books made no mention of the Erie Canal. Evidently the authors had not discovered that this was an important topic. One of the earlier books has the following statement: "1817 Erie Canal from Albany to Buffalo begun." Another text has this statement: "In 1815 New York began the Erie Canal which was completed in 1825." A somewhat fuller statement from a third book runs as follows: "Public improvements — the greatest of these works then in progress was the Erie Canal which connects the waters of Lake Erie with the Hudson River and the grain fields of the West with the markets of Europe. It was formally opened in October, 1825, when the Governor of New York and many guests sailed from Buffalo to the city of New York in a state barge attended by music and the roar of cannon." A fourth and later book contains the following account:

The Erie Canal

"The Erie Canal connecting the waters of the Great Lakes with the Atlantic was completed in 1825. The canal passes from Lake Erie to the Hudson at a point near Albany. It was constructed by the state of New York, eight years being required for the work. The success of this great undertaking was mainly due to the untiring efforts of Gov. De Witt Clinton.

"The canal brought N. Y. City in close touch with the West and its benefits were immediately felt. The cheapening of freight rates made a marvelous increase in the amount of products exchanged between the East and the West. The canal became also a popular route for the emigrant as it was an easier way than the overland route of reaching the West."

This paragraph brings out several important results from the building of the canal and furnishes considerable food for thought. A fifth book quoted gives the following:

The Opening of the Erie Canal, 1825

"John Quincy Adams was the sixth President we elected. We have seen that the people living in the eastern states had a great desire to open up ways for reaching the country west of the Allegheny Mountains. The construction of the National Road did much to help them but the state of New York resolved to dig a canal reaching from the Hudson River to Lake Erie.

"In some ways this would be far better than a road, because it is always easier and cheaper to carry passengers and freight by water than by land.

"Gangs of laborers began to dig at Albany. After eight years of hard work the last shovelful of earth was thrown out, and the long ditch was completed, 1825. It ended at Buffalo, three hundred and sixty miles west of the Hudson. The canal was the greatest piece of work of the kind that had ever been done in the United States.

"People could now start from New York City by steamboat, go to Albany, step on board of a canal boat, and in less than a week they would arrive at Buffalo. That was quick traveling for those days. Then, if they liked, they could take a steamboat on Lake Erie and go to Cleveland, Ohio, or to Detroit, Michigan, or even as far west as Wisconsin — and that was then thought to be very far west indeed.

"Thousands of emigrants went west by the canal. A part of them pushed on beyond Buffalo and settled in the states which border on the Great Lakes. But many of

them stopped at different places in New York. They built up the cities of Utica, Syracuse, Rochester, and Buffalo, besides many smaller towns along the banks of the canal.

"The canal brought wheat and farm produce from the West to the East, and it helped in many ways to make New York the 'Empire State' — that is, the greatest state in population and wealth in the Union."

This treatment is fuller and more interesting and suggests a comparison with the Old National Road. It takes a much broader view of the geographical and commercial relations of the Erie Canal, of products shipped, and of emigration. It suggests a somewhat full geographical study of the whole situation.

A still more recent history textbook is quoted as follows:

"The Erie Canal; the Pennsylvania Canal. — But an event of far greater importance than the extension of the National Road was the completing and opening of the Erie Canal in 1825. We learned (p. 208) that the effect of the steamboat navigation in the West was to build up the Gulf trade. The Ohio farmer could ship his grain by water to New Orleans, and receive a price sufficient to pay the freight and still leave a fair profit; but if he should send it by land over the mountains to the Atlantic seaboard, the cost of transportation would be more, perhaps, than the grain was worth. So it was as natural for the Western trade to find its way to the Gulf ports as it was for water to run down hill. But the business men of New York, Philadelphia, and Baltimore saw that they would suffer great loss if the Western trade were allowed to slip away from them. The National Road, to be sure, would save to

the East a part of that trade; but, at the best, goods could not be moved as cheaply on roads as on rivers. The people of the seaboard, therefore, began to look to artificial rivers, that is, canals, as a means of securing the Western trade.

"Canal-building on a large scale began in 1817, when De Witt Clinton, governor of New York, turned the first spadeful of earth on the Erie Canal, which was to extend from Buffalo to Albany, and to connect Lake Erie with the Hudson River. Clinton had persuaded the legislature of New York to undertake the building of the canal at the expense of the state. He promised that the canal would draw trade from all the Great Lakes and their tributaries and from a large part of the Mississippi Valley besides; that this trade would find its way down the Hudson to New York and cause that city to become a great commercial center; that villages, towns, and cities would line the banks of the canal and the shores of the Hudson from Erie to New York; that 'the wilderness and the solitary place would become glad, and the desert would rejoice, and blossom as the rose.' The work of digging the 'great ditch' was carried forward in earnest, and in 1825 the canal was completed and thrown open to the public.

"The opening of the canal was celebrated in a manner worthy of so great an event. On the 26th of October a fleet of gayly decorated boats left Buffalo and moved slowly eastward along the canal, 'saluted by music, musketry, and the cheers of the crowds along the bank.' On the morning of the 4th of November the procession of boats reached the city of New York. A flask of water from Lake Erie was poured into New York Bay by Governor Clinton, and the waters of the Great Lakes were declared to be united forever in marriage with the waters of the ocean.

"The canal did all that Clinton promised that it would do and even more. Before it was built it cost $100 to carry a ton of goods from Buffalo to New York City; the canal reduced the cost to $20. The cheap freight rates caused trade to flow in great volume toward the canal. Within a year after its opening the canal bore on its quiet waters many thousands of boats and rafts laden with lumber, grain, furs, and merchandise of all kinds. Villages and towns sprang up along the line of the canal from one end to the other. Western New York indeed 'blossomed as the rose.' Utica, Syracuse, Rochester, and Buffalo rapidly developed into flourishing cities. But the greatest thing done by the Erie Canal was to build up the trade of New York City and make it the commercial center of the United States and of the Western Hemisphere.

"The Erie Canal was hardly finished before the State of Pennsylvania also began to construct a system of canals from Philadelphia to Pittsburgh. It was necessary to do this if Philadelphia was to hold her Western trade. In 1826 work on the Pennsylvania was begun, and nine years later one could travel by a horse-railway from Philadelphia to the town of Columbia on the Susquehanna; thence by a canal along the Susquehanna and Juniata to Hollidaysburg; thence over the mountains by a portage railway to Johnstown; and thence by canal to Pittsburgh.

"Railroads. — It was necessary also for Baltimore to have an easy route to the West, but the men of this city looked to the railroad rather than to the canal as a means of communication. On the Fourth of July, 1828, the venerable Charles Carroll of Carrollton, who fifty-two

years before had signed the Declaration of Independence, laid the cornerstone of a railroad that was to connect Baltimore and the Ohio River."

This is the fullest account we have seen in our recent histories and it amounts to a fairly elaborate discussion of transportation between the Eastern seaboard and the great Western regions beyond the Alleghenies and about the Great Lakes.

This treatment gives a larger account of the causes leading to the construction of the canal, a fuller detail of the actual work, and a clearer statement of the results. But it goes beyond this and shows how Pennsylvania worked out a similar plan of railroads and canals and how Baltimore built a complete railroad to the West.

The above extracts, taken from six different histories, show a disposition on the part of historians to seize upon an important topic and to enlarge upon it more and more.

The following is suggested as a more nearly adequate treatment of this topic, illustrating the organization of knowledge around such an important center. The Erie Canal has been so important in the historical growth of the United States, while its character as a main traffic route is so typical and its relations to the largest railroad lines so close, that we deem it a suitable example upon which to illustrate the organization of knowledge around a central idea on a large scale. The following treatment of the Erie Canal, first as a fuller description of a single big engineering project, and secondly, as a series of comparisons with other waterways and railways connecting the East and the West, furnishes a complete illustration of a steady, progressive thought development and of a strong central organization of a great number of important facts from

the history and geography of the United States. It is a good example of what we mean by the *big project or unit of study.*

The Erie Canal

The project of building a canal to connect the Great Lakes with the Hudson and New York City was thought of before the Revolution. But so long as the warlike Iroquois or Six Nations held control of central New York, the building of roads and canals across this country was out of the question. General Sullivan's army marched into the Iroquois country during the Revolution, in 1779, and broke up the strong union of the six nations that for two centuries had ruled central New York and had been feared by all the Indian tribes far and wide.

At the close of the Revolution, then, white settlers were free to push into the valleys, lake regions, and forests of central New York as far as Lake Erie. Along the old Indian trails from Albany to Lake Erie were now to be laid out the wagon roads and later the canals which were to connect the East and the West. Even before the Revolution bold settlers had flocked across the southern Alleghenies into Tennessee and Kentucky and had taken possession of those lands under such leaders as Boone and Robertson and George Rogers Clark. A little later pioneers drifted into the Ohio country, and now after the Revolution there was a growing demand for roads to connect the western settlements with the older states east of the mountains.

A pioneer road was laid out through the forests and swamps of central New York to Lake Erie. The early settlers of this rich region soon had supplies of wheat and

peltries to send East, that is to New York and Philadelphia, and they needed cheap and easy transport. In the spring, when the rivers were flooded, they could send boatloads of goods down the Susquehanna to Philadelphia and Baltimore. The valley of the Mohawk was also used for the shipment of goods to New York, partly by boat and partly by wagon. The wagon road from Albany to Buffalo was a long and tedious haul through woods and swamps, and it cost about a hundred dollars to get a ton of freight from Buffalo to New York.

The project of building a canal from Buffalo to Albany was early suggested. Gouverneur Morris argued that as Lake Erie was 570 feet higher than tidewater at Albany, it would be possible to dig a channel and convey a stream of water that would carry boats directly to the Hudson. De Witt Clinton, afterward governor, was a strong advocate of such a canal, and he, with others, had surveys made and formed plans. But the undertaking was too difficult and expensive for private individuals.

Only a large state like New York could supply the money necessary for such an undertaking. Finally De Witt Clinton presented the matter to the legislature of New York in 1816. Some of his arguments were as follows: Such a canal would greatly cheapen the transport of goods from Buffalo to New York. This would make New York City the outlet for goods coming from the lakes and the Ohio country as well as from central New York, and in this way it would rapidly grow into a great city. Again, New York State was fortunate in having the only route between the East and the West where there were no mountains to climb, as in Pennsylvania and other states farther south. It was the only place where a canal could be built.

The shipment of goods down Lake Ontario and the St. Lawrence would only injure New York State, and besides, the St. Lawrence was blocked with ice during a long winter.

The country through which the canal would pass was a rich and fruitful region, and with a good canal for shipment it would settle up rapidly and become very prosperous. The canal itself could be easily supplied with water from Lake Erie, and the boating along the canal would be much safer, being free from the winds and storms which prevail on the lakes and on the ocean. A pair of horses or mules could haul a great canal boat loaded with goods along the canal at the rate of thirty miles a day, and that would be very cheap and rapid compared with any other kind of shipping. After much discussion these arguments won the day, and the legislature voted to undertake the construction of the canal at state expense.

It was decided that the canal was to be dug along the Mohawk Valley, then across New York north of the Finger Lakes, not far south of Lake Ontario, to Buffalo. The main canal was to be divided into three sections, the western part from Lake Erie to the Seneca River, the middle from the Seneca River to Rome, and the eastern section from Rome to the Hudson at Albany, in all 365 miles. It was to be 4 feet in depth, 40 feet wide at the top, and 20 feet wide at the bottom. The sloping sides were to be walled with stone to prevent washing.

The first contracts for digging were let in the spring of 1817. The farmers along the route had been engaged to do the work, at first with spades and wheelbarrows, but this was too slow, so scrapers were invented to be used with teams and oxen. This made the work go much faster. Money was scarce among the farmers and they were

glad to engage in the work to get ready money for their needs.

A number of serious difficulties hindered the progress of the work. First were the great forests, thick and tangled, just west of Rome. Trees must be cut down and stumps pulled. The ground was deeply matted with roots. A stump puller was sent from England, and a great plow with two yoke of oxen was used to loosen up the roots. In some places the canal led through swamps, and hundreds of men were sick with fever and ague. Thus, for a while, near the Seneca River, the work almost stopped. Other stretches of the canal had to be quarried out through rock, and this was slow and laborious.

Important rivers like the Genesee had to be crossed, and this was a serious problem. Massive stone arches were built across the valleys and streams, and stone troughs or aqueducts were built upon these, which formed part of the canal. The rivers then could pass under these arches and aqueducts.

The canal had to be built at several levels, on account of the hilly and sloping nature of the land in places, and had to pass from one level to another, say ten feet higher or lower. At these places stone locks must be built, with double gates at each end, and constructed long enough and wide enough to let boats pass into them so as to be raised or lowered as the water was let in or out.

Work was going on in all these sections at the same time. As fast as any considerable part of the canal was completed, the water was let in, canal boats were built, and goods shipped. The charges on these shipments or tolls counted up rapidly to a large sum and people began to see that the canal, when finished, would be very profitable.

At last the canal in all its parts was completed in 1825, being 365 miles long, and having seventy-two locks and many stone aqueducts. It crossed the Mohawk River twice. Its entire cost was $7,600,000, a large sum for those days.

Of course the completion of the canal was celebrated in Buffalo and New York and all the towns and cities between. As Governor Clinton and a party of guests entered the canal in boats to travel to New York, a cannon was fired off, and this shot was followed by a series of cannon distributed along the whole route within hearing distance of one another. In this way the news was telegraphed to New York. All along the route they were received with speeches, feasts, and jollification, and at New York two kegs of water from Lake Erie were poured into the New York Bay to signify the union of the lakes with the ocean. It was really a great event in American history, as the products of the West could find easy transport to New York and to Europe by water. Settlers going West could travel easily to the states bordering the Great Lakes.

Important results quickly followed the completion of the canal. On the opening of the Erie Canal in 1825 the cost of freighting a ton of goods from Albany to Buffalo fell from $100 to $6 and later to $3. The whole farming country for miles back on both sides of the canal grew quickly into a rich, productive region. All along the canal cities sprang up which in time have grown into large and populous centers of manufacturing. Nearly all the large cities of New York State are located on or near this canal and the Hudson. Smaller canals were built south and north of the Erie connecting it with the lakes and greatly increasing the trade. The success of the Erie Canal was greater than even its friends had expected. The tolls from

1825 to 1834 amounted to eight and a half millions, more than the original cost.

From the Ohio country and from all the Great Lakes region, products began to flow in toward Buffalo and along the canal to Albany and New York. The Eastern people, desiring to move West, found it easy to transport their families and goods by the canal and lakes to Cleveland, Detroit, and Chicago, and to move out to farms in Illinois, Indiana, and Michigan. Passenger canal boats were built and much used.

From the opening of the Erie Canal, New York City began to grow and soon outdistanced all other cities in the United States in wealth and population. For some thirty years this canal was the chief highway of traffic for heavy goods between the East and the West. It was also the chief mode of travel for people and families going between the East and the West. During this period the tolls on the canal brought in a large revenue to the state.

Cities like Philadelphia and Baltimore, on the Eastern seaboard, were very anxious to share with New York the rich commerce of the West. Even before the building of the Erie Canal the government of the United States had constructed the Old National Road from Cumberland on the Potomac, across the mountains and through southwestern Pennsylvania to Wheeling on the Ohio. This road was afterward completed across Ohio, Indiana, and Illinois to St. Louis, and cost the government about $7,000,000, not much less than the Erie Canal.

It was a well-built stone road as far as Wheeling, with massive stone bridges, and to this day it is a good, solid highway. For many years it was thronged with wagons and emigrants and their stock and goods, moving to the

West into the Ohio Valley. The old hostelries or hotels along the road are yet fine old landmarks of the day when Henry Clay, Andrew Jackson, and Abraham Lincoln traveled over this road by coach to Washington.

Philadelphia sought to reach the West by still another route. Canals were built by the state along the Susquehanna and up the Juniata to the edge of the mountain ridge between Johnstown and Altoona. It was intended to carry the canal through this mountain wall by a tunnel. Another canal on the west side connected Johnstown with the Allegheny River and Pittsburgh. But the tunneling of the mountain proved too difficult, and a portage railroad was built over the mountain to connect the two canals, at state expense. Another railroad was built by the state of Pennsylvania from Philadelphia to the Susquehanna, and thus Philadelphia was connected, from tidewater on the Delaware, by combined railroads and canals, with the Ohio at Pittsburgh. This became a great route of traffic between the Ohio country and Philadelphia. It competed with the Erie Canal for the trade of the West.

During this early period we find three great routes competing for this Western trade. All of them were very important in the development of the West and in bringing about an easier interchange of products between the East and the West. Make a map showing these three routes. How did they rank in importance? What cities were connected by them?

Between 1840 and 1850 railroads were projected and built across the Alleghenies to assist in handling the immense traffic that was growing up and to bring about a much quicker and cheaper transit of goods and persons over long distances. It was only gradually and slowly

that engineers and capitalists learned how to build and manage railroads. At first they were very crude and clumsy. Instead of engines they used horses and mules to draw cars, and there were no cross ties connecting the two rails. There were no stations or freight houses, no regular times for trains to start, no headlights, no sleeping cars, no telegraph.

The New York Central Railroad, at first built in sections and afterwards combined into one road, ran parallel to the Erie Canal between Albany and Buffalo, and on down the Hudson to New York. When this railroad connection was completed, goods and persons could be transported much more rapidly, and a large share of the trade was transferred to the railroad. But so great was the volume of trade that both canal and railroad were kept busy. Freight rates on the canal were so much cheaper for heavy produce that for grain and farm products it was much better to use the canal. The cheap rates on the canal kept down the railroad freight rates.

In the early years the canal was so successful that people began talking of enlarging it. By making it deeper and wider, larger canal boats could be used and transport would be cheaper still. In 1835 it was decided to enlarge the canal, making it seventy feet wide at the top and seven feet deep, and at the same time larger double locks were to be constructed. This was a costly undertaking and its working out was not completed until 1862. This great improvement cost fifteen millions of dollars, nearly twice the original cost of the canal.

The competition between the canal owned by the state and the railroads owned by private companies continued. The New York Central built double tracks across the

state and later increased them to four tracks, so vast was the volume of business with the West. Other railroads across New York to Buffalo, as the Lehigh & Lackawanna, were also built, and there was plenty of freight for all.

Finally, to enable the Erie Canal to compete with the railroads for the Western trade, a second and much greater rebuilding and enlargement of the canal was talked about. The great railroad systems must not be allowed to gain a monopoly of trade and fix freight rates. There was a hot political campaign in New York State while Roosevelt was governor, and at the end it was decided by a large majority of the voters of the state to spend one hundred million dollars enlarging the Erie Canal. This really meant the building of a new and much larger canal. The course of the canal was considerably changed, the Mohawk River was to be deepened and canalized and pools formed by means of locks. The canal is 125 feet wide at the top, 12 feet in depth, and is able to float barges carrying 1,000 tons of freight. Great locks are built, large enough to pass two of these barges at once. This improvement makes the Erie Canal one of the greatest canals in the world and not only furnishes a cheap transport of Western products by water to the seaboard, but will compel the railroads to keep their rates low.

A comparison of canal building and railroad construction across the state of New York, from New York City *via* Albany, Syracuse, and Rochester to Buffalo, with the canals and railways from Philadelphia *via* Harrisburg and Altoona to Pittsburgh will bring out the fact that the people of New York and Pennsylvania have spent vast sums of money in first constructing and in later developing these important traffic routes between the Ohio and the Great

Lakes on one side and the Atlantic seaboard cities on the other.

During this early period, also, the people of Maryland undertook one of the first great railroad projects in building the Baltimore & Ohio Railroad from Baltimore to Wheeling, and later to Cincinnati. A canal was also constructed along the Potomac from Washington to the mountain ridge. At a later time the people of Virginia secured a railroad from Norfolk through Richmond across the mountains to Charleston, West Virginia, and Cincinnati.

The people of Massachusetts were as anxious as those of other states to secure a full share in the rich traffic of the West. They early surveyed the route from Boston to Albany for a canal and at state expense undertook the digging of the Hoosac Tunnel, five miles in length, through the high mountain ridge which stretches across western Massachusetts. The canal was afterward given up in favor of the Fitchburg Railway which passes through the Hoosac Tunnel to Albany. The Hoosac Tunnel cost the state seven million dollars, nearly as much as the Erie Canal.

The people of Canada were sorry to see the traffic of the Great Lakes region turned down the Hudson by the Erie Canal. In order to secure their share of the lake traffic the Canadians built the Welland Canal from Lake Erie across the peninsula to Lake Ontario, at a cost of fifteen million dollars. This canal enabled vessels to pass from the lower St. Lawrence to the upper lakes around Niagara Falls. It was also necessary to build a canal and locks just above Montreal to allow vessels to pass around the long rapids in the St. Lawrence.

All the way from Canada to Virginia the people of

America were alike interested in one problem. All these big, expensive schemes of canal and road building were efforts to solve the problem of cheap transport between the East and the West, to connect the waters of the Ohio and of the Great Lakes with tidewater and with Europe. The rich products of the western plains must be gotten to market and the manufactures of the Eastern cities and of Europe must be carried to the rich country beyond the Alleghenies.

The great success of the Erie Canal suggested similar undertakings connecting the rivers and lakes of the West. In 1848 the Illinois-Michigan Canal was completed, connecting Lake Michigan with the Illinois and Mississippi rivers, and serving as a means of carrying on a large traffic. Several canals were built across Ohio and Indiana connecting the Ohio River with Lake Erie.

In recent years a project for a deep water route by way of the Chicago Drainage Canal and the Illinois River to St. Louis and the Gulf has been seriously proposed. The deepening of the Upper Mississippi from St. Paul, of the Ohio from Pittsburgh, and of the Missouri from Omaha has been proposed as a part of this great system of deep water navigation. The completion of the Panama Canal has opened up a prospect for turning the commerce of the West down the Mississippi to New Orleans and thence by way of the Panama Canal to distribute it to the countries surrounding the Pacific Ocean.

The Panama Canal seems, in a sense, a means of competing with the Erie Canal for the traffic and products of the Mississippi Valley. The products of the Mississippi Valley would naturally flow southward to find their outlet to the world. In the early pioneer days before roads

were constructed across the Alleghenies, these products were sent down the Mississippi to New Orleans. The Illinois Central Railroad is now again carrying on a large traffic between the North and the South, and other important roads have developed a similar trade. The future is likely to see a great increase in the North and South traffic in staple products. The fruits, vegetables, rice, cotton, and sugar of the South will move northward and the grains, meats, and machinery of the North will move southward.

Conclusions

The following conclusions may be drawn reasonably from the foregoing illustrations and discussions:

1. There is a strong and growing tendency to select and develop large teaching units, as illustrated by big projects or type studies.

2. The more important the unit of study the stronger is the impulse to expand it to a full and adequate treatment.

3. These large, well-organized knowledge-units become first-class teaching projects and give a sound basis for complete class instruction.

CHAPTER VII

SIMPLIFYING STUDIES ON THE BASIS OF LARGE PROJECTS

How to get at the simple basis of knowledge, how to master its main elements without waste and confusion, is surely a vital question. We wish to discover a sound basis for simplification of studies. The simplicity of knowledge seems to come into view in its big, central ideas and projects. The key to the situation may be had if we can find the strategic centers in school studies. The projects discussed in Chapter I are large, important units of study. As such they are a good substitute for our present miscellaneous collections of knowledge and are the chief basis for reorganizing our plans of instruction in the interest of simplicity.

The increasing number and complexity of studies in the curriculum have had a more or less confusing effect. We have been adding new studies and changing old courses at such a rate as to throw the machinery of instruction into disorder. There is too much crowding and congestion in the knowledge program. Learning as displayed in the various studies is also dribbled out too much in small bits and fragments. Facts and ideas that ought to fit together and combine into larger units fall into broken and disconnected parts. Such scattered items and fragments of information are disappointing because of their failure to give the larger

The present confusion in studies

surveys of knowledge and the deeper insight into important subjects, the real simplicity of knowledge.

Centers for assembling and organizing facts

The school program should require a small number of big units well organized rather than a large number of small topics scattered and disconnected. A clear setting forth of the strong, developing features of one big city like New York, in its local and world relations, followed by detailed comparisons with other leading cities, is more instructive than the mere names and location of hundreds of towns and cities scattered through forty-eight different states. It is needful thus to focus attention upon the conspicuous centers where facts and forces group and organize themselves and display their influence in a simple, almost spectacular way. Mere facts in any study, not grouped and related to any strong, replete center of thought, are well-nigh meaningless and worthless. They should be left in the junk heap and not imposed upon children as knowledge. The ragpicker and garbage collector have a true function, not so the student who is collecting odds and ends which, as unrelated fragments, lead to no important conclusions.

The simple basis of knowledge is lost sight of

Our schools have been forced into this small business of dealing with numerous fragments and disconnected facts by a somewhat rapid and disorderly accumulation of studies and by compressing a great variety of knowledge into a small space. Our recent curriculum has been deluged by a varied mixture of unordered materials. Both teachers and children have been thrown into such a mess of knowledges that we have almost lost the notion that there is any simple principle of organization.

The child is out on a voyage of discovery and exploration in a universe of new things. He has some eight years (from six to fourteen) to circumnavigate this earth and to return home laden with world experience. The seemingly detached and scattered facts surrounding a child are infinite in number and variety. If education consists in memorizing as many as possible of these mere bits and parcels the child has a tedious and hopeless task. He is going into a labyrinth from which he will never emerge into daylight. The fundamental, the simple, is above all things necessary. The field of knowledge, taken as a whole, is vast and limitless. Quantitatively measured the amount of information gathered by any child must be extremely small, a mere fragment of the whole. It is therefore of the utmost importance that we be highly selective in the few important things we require of children. Only the best, the most necessary and typical, should be thought of.

Chaotic knowledge a hopeless task

We take it for granted that it is the purpose of education to let the child into the secret of the world system, to give him a prompt and far-reaching interpretation of the orderly world, to make big discoveries and to make them rapidly. He has no time to waste in learning naked, lonesome, meaningless facts. He should travel a road that leads to important places, to real knowledge of the few essentials. The child has a right to know this world and to understand it. It is a new, complex, bewildering world and if he gets muddled and discouraged in his approaches to it, confusion becomes worse confounded. We are guiding the children in the search for these simple approaches to world knowledge, hoping to reach and travel with them the main highways of thought.

Letting children into the secret

The child, too, has in his brain a machinery of thought with which to make these discoveries. But his own machinery for thinking is as strange and new to him as are the objects of the outside world. He is new to himself and needs a guide to show him how to use his powers. The world at bottom is simple and the child, if rightly guided, has the mental power to grasp this simple world structure. It is the business of teachers to find in the important studies the few main centers or avenues of thought and to set them forth in simple, objective illustration which a child can understand.

A few simple ideas rule the world

To make a proper acquaintance with the world, then, the child should not be required to wander through an infinite network of roadways and bypaths, but should be guided wisely along a few main highways so as to get the general topography and the striking, important features of the landscape. Neither a jumbled collection of small topics nor a disjointed multitude of important facts will satisfy a child's necessities in the way of knowledge. He should be led to find the few strategic centers of knowledge by the full and prompt mastery of which he will soon be able to discern, to organize, and to control his world. The child should be allowed to discover that a few big, simple ideas rule the world. As the rising sun illumines the earth, so a great idea sheds light and meaning far and wide. The life history of an oak tree from the acorn to maturity can be readily grasped in its essential features by a child, and with this as a basis he can soon interpret the life of many kinds of trees and of great forests. A locomotive engine is an elaborate combination of mechanical elements and shrewd invention, but the expansive power of steam applied in the case of a

simple boiler and steam chest can be easily demonstrated. Yet upon this one idea is based largely the growth of our vast railroad system and steam navigation. Even the complexities of social and institutional life yield to simple interpretations. The story of the Good Samaritan sets forth clearly a principle of conduct which, once applied, as it ought to be, would improve conditions of human life throughout the world. As a whole, human society is a complex organization, but the ideas that should control and organize it are simple and easily intelligible to a frank, unprejudiced mind.

From these and other illustrations we might conclude that a few ideas concretely and amply demonstrated to a child would go a long way toward explaining the world, would at least put him on the track of discovering and interpreting the larger forces that govern and organize his own life and the life about him. Such studies should give a child first, broad surveys of extensive knowledge areas and, secondly, a deepening and enriching insight into the meanings which lie back of the endless objects and activities observed.

Just as a few large rivers drain the continents, so a few channels of thought drain out the meaning of whole studies. If we could find a few trunk lines of developing thought in each school study and then organize and master knowledge on this basis, we might greatly simplify and enrich the processes of learning. As instructors we should direct our attention very sharply to this peculiar quality and tendency in knowledge, namely, to get itself strongly and intensely organized at a few centers and to run deep and strong in a few main channels. These large teaching units, objectively demonstrated in each study, are the true high-

ways of knowledge for children. This is a simple, democratic view of education which strips it of its complexity and puts it within reach of every child.

The nature of knowledge suggested through analogies

Knowledge, like wise military tactics, has strategic centers where it is strongly organized and becomes powerful for offense or defense. If we desire to understand complex military operations we study out the influence of one or more of these strategic centers.

Knowledge, like the trunk line of a railway system, draws all goods and travel into this central traffic movement. If we seek to master the extensive commerce of a great country, we study one of its central traffic routes and compare it with others.

Knowledge, like a tree, organizes its life forces and builds up its structure around a central axis of growth. If we wish to understand tree life and the meaning of forestry, we study carefully the life history and growth of one great forest tree in its relation to other trees, to soil and surroundings, and to man.

Knowledge is like a machine in operation. It works out a process looking toward a definite, desired result. A loom is a machine built and adapted in all its parts to carry on the process of weaving cloth. Study out the parts of this one machine and see how they coöperate to produce cloth by the act of weaving and we shall understand the basal principle of weaving and of all textile industries the world over.

Knowledge, like a power plant at Niagara, produces and brings under control a thought energy which can be turned to account in many fields of experience. Study out and completely understand the Niagara power plant and on that basis we can judge the value of water powers along the

mountain streams and big rivers throughout our whole country, and later in other countries. This is one of the big conceptions that is organizing modern industry, working along the line of scientific knowledge.

Knowledge, like any well-thought-out human project in industry or government, has in it a controlling, organizing idea, working out a rational whole, for example, a transatlantic cable, the Brooklyn Bridge, a city waterworks, the Suez Canal, the flour mills at Minneapolis. On this basis our modern industries and human occupations are now organized and rationalized as big knowledge units, as complex thought wholes. It requires comprehensive brains nowadays to organize and manage big business, because such a business enterprise is a large, organized, objective unit of thought. If the schoolmaster wishes to find out and train himself in great, simple thought processes, let him study the important, well-organized industrial projects. Nowhere else will he find such close practical adjustment of great thought processes, to necessary life conditions, as in the human occupations. Nowhere else will he find better compacted and organized thought units. They are big, objective demonstrations of man's power to think and to organize the materials of thought in relation to human needs. They are important projects which serve as good object lessons for children's full and careful study.

How facts grow into knowledge

In other words, whenever we study properly any important new subject, the elements of knowledge, the facts, are in the process of grouping themselves into a larger unit, often into an objective whole, as, a factory, a railroad, a military campaign, a masterpiece of literature. The facts, until they get themselves

organized into these large groups or central units, have little or no meaning, are not knowledge properly speaking. Facts in order to become knowledge must get into some organization, into some rational whole, and this in turn may be a vantage ground for interpreting other similar wholes in still larger groups and in whole series.

Thus facts and so-called materials of knowledge do not seem to find any good stopping place until they develop into a consistent whole, and find themselves brought together by some principle of unity. The purposive process by which the facts have come together develops them into an organic unit. As learners, until we reach this point where organization sets in, we are in helpless confusion. We cannot see the woods for the trees. The teacher, of course, ought to see the end from the beginning. This big, organizing unit of thought has already worked out its full course in his mind in its essential order. Otherwise he is but a blind leader. Learning is the process of thinking out these large units or projects in their natural growth and organization.

Proper learning is growth and organization

The teacher should keep this central unit of thought, this purpose, like a pole star, clearly in view or else he, too, may become a wanderer among dead facts, surrounded with graveyard knowledge. He may be merely reading tombstone inscriptions. The children require wise guides to keep them headed toward the main centers, these beckoning and summoning peaks of knowledge. Like Bunyan, they should keep the Delectable Mountains plainly in sight.

At the end of every important series of lessons the children should come out into a broad place with an open view.

This brings a regrouping of abundant facts and experiences into a new and important conception, a fresh and valuable interpretation of the world from a better standpoint. Until they reach this point where knowledge has organized itself into a well-rounded unit of study fully mastered by the children, they stop short of any true accomplishment. No amount of memory drills on stark facts is a substitute for knowledge. In such case our house is still only half built, our bread is only half baked.

A well-rounded unit of knowledge

On the basis of the previous discussion we may get rid of a false notion as to what knowledge is. A collection of miscellaneous facts about a subject is of such inferior grade from the standpoint of true knowledge that we are willing to discard it. Passing an examination on these facts with a high grade is not a proof of scholarship. It is quite conceivable that a person may have an extensive memory of facts in geography, science, or history with little perception of meanings, relations, and values, combined with small power of interpretation or use. In the schools to-day there is more or less predominance of this superficial — what might perhaps be better called false — knowledge. Our whole course of study is much cumbered with miscellaneous, ill-assorted facts and formulæ which have not yet emerged into knowledge. There is too much straggling information or misinformation. A whole army of stragglers isn't worth much. Teachers are still much under the dominance of the fact-cramming, storage theory of knowledge. They are not yet convinced of the organizing quality and strength of important, controlling, purposive ideas. Among teachers generally there is a lack of perspective with regard to

A false conception of knowledge

big things *versus* little things. They are not yet clear as to what the real, purposeful centers of thought are, around which the facts may best be organized.

The vital element of knowledge in a big unit lies in its principle of growth and organization, not in the facts as such. The incorporation of facts into a growing project like the building of a railway, or the lay-out and construction of a city water system in New York, for example, brings these facts together into their proper relations, and absorbs them into an energetic, forward, practical thought-movement. This leads on to the solution of an important problem vitally related to city and state. The energizing principle of growth and organization toward some desired and much-needed end should carry forward the thinking processes of children in every topic to a well-matured result. This formative, creative idea is also the working principle that constructs a good story like the *King of the Golden River*, or Dickens's *Christmas Carol*, or a poem like *Horatius at the Bridge*. The thought energy is pushing forward and must have a chance to realize its purpose. The dynamic quality that organizes and develops a big teaching unit must be in evidence or else the distinctive quality that characterizes true knowledge is absent. The salt has lost its savor. When a topic has been thus denatured, it should be banished from the school.

This complete unit only a beginning

Each project or unit of study as it grows and organizes the materials essential to it, when it has once developed into an energetic thought movement and has brought a new and valuable interpretation to bear upon the world, has just barely begun its useful career. It has become in the child's mind a life center around which other kindred subjects in the

future will group and organize themselves in a still larger expansion of knowledge, because it is based upon a constructive idea which produces similar effects under a variety of conditions.

We sometimes call one of these completed units of study or strategic centers in knowledge a *type*, because it has a marked and characteristic quality which seems permanent and reappears on many occasions and in many other big topics. Moreover we are pleased to find a few things in the world that are typical, that are more stable and permanent, not subject to the prevailing law of change. The type fixes a permanent quality in a whole series of shifting, changing topics. We are tempted even to give fixity to ideas as types, as if they had set like a chunk of cement into a rigid form and had become a fixed pattern. But knowledge, in the quality of ideas, resents this sort of stiffness and cramping limitation. If ideas can be called types, they are variable. They are types of growth and progress. An idea is a growing, organizing principle. When it ceases to grow it ceases to be. Variation under the type is the law of growth.

The type combines stability with growth

And yet the notion of types in knowledge will properly assert itself and claim serious consideration. Indeed the type serves an important purpose. Nature has at least a few great patterns on which she constructs her life forms and develops the life processes, *e.g.* the vertebrate structure in animals, the endogens and exogens among trees. The study of type forms among vertebrates lays the basis for a quick understanding of innumerable kindred forms in later studies. We are compelled to admit that a standard ear of corn is a nearly perfect type of millions of ears; that an average white pine,

The type simplifies knowledge

in life history, structure, and function, is a good type of white pines in general, and in varying degrees, of all pine trees, and in a less degree of all trees and vegetable growths. In the same way the cecropia moth in its metamorphosis is a type of moths and of insects. New York harbor is a type of large harbors; Mt. Shasta of volcanoes; Webster of statesmen. If a child is to get an appreciation of world order and system, so as to adjust himself to his surroundings, the elaborate study of a few fundamental, growing types is the shortest and best road to this end. It results in a marvelous simplification of a seemingly complex world.

The type dominates the past and the future

It is true that the predominance of types everywhere in evidence in the world lends something of monotony to the forest of pines, to the wheatfield, to the dress and customs of people. Nature repeats her forms with slight variations in countless millions of individuals, and the mastery of a few of these leading types in their origin, growth, and relations is far-reaching in its power of interpretation. When an important unit of study has been fully demonstrated as a good type of thousands or millions of similar objects or phenomena in the world, it not only explains many similar things in the present, but it becomes the basis for a continuous expansion and enrichment of the fundamental idea in the type for future uses. This same idea is at work in the world on a grand scale, under changing conditions, producing kindred results. To go on following and interpreting this idea in its new surroundings and in conjunction with other forces in the world will develop an alert and versatile mind. Education should see to it that a child first thoroughly gets these basal ideas, and secondly, that he is kept busy turning them to account in new situations.

The child's experience should grow on and on in richness along each typical highway of thought.

The school can afford the time and effort required to teach a few great, simple lessons thoroughly, richly, copiously. It may well exhaust its amplest resources in concreting, expanding, and applying a very few primary types of human behavior, of social and industrial activity, and of natural phenomena. Among teachers the wisest should set themselves to the task of selecting among big things the most important, among superior types the more highly significant and far-reaching. Then from those superior topics, by a sifting process, they should reselect and choose again the better half. We are then prepared to gather together and concentrate upon these focal units those rich knowledge resources which will intensify the organizing ideas in these topics. The best is good enough for children. But the best is never at its best until it is framed up in its full natural environment and life relation, until it is given an objective, artistic setting. Here is the problem of the teacher.

A sifting and resifting till we find the basal types

This is another way of saying that knowledge is simple, continuous, and consistent throughout; that the ideas we start with in the early education of children are the selfsame ideas, naturally developed, which we shall come out with at the end of our school course. They are so simple and far-reaching that they continue to grow to the end of life and dominate its results. Education itself is a life process, a continuous growth and expansion along a few basal lines of thought throughout the whole life period. It is dynamic in its forward, constructive, organizing movement.

The simplicity of knowledge

This process of simplifying knowledge through organization along a few main channels of thought provides also for that ample enrichment of every big topic which gives it the complete, wholesome effect of real knowledge. The intensive enrichment of main topics is the subject of our next chapter.

Our conclusion is that we should get rid of the static conception of knowledge, that we should throw overboard ill-assorted, miscellaneous collections of facts, and that we should focus attention upon those ideas and projects which are strongly purposive and far-reaching in their scope and influence. Then we shall be surprised at the marvelous simplicity that comes from a clear insight into a few basal things, that is, from the proper organization of knowledge around growing life centers.

CHAPTER VIII

THE ENRICHMENT OF INSTRUCTION BY THE INTENSIVE TREATMENT OF LARGE UNITS

One of the main problems of modern education is how to make profitable use of the large increase of knowledge that has deluged our curriculum with the influx of new studies. To what extent do these projects as large teaching units give adequate expression to this greatly increased content of elementary studies? For several years there has been in progress a vigorous campaign for putting a deeper content into common-school instruction. The new subjects, including biography, literary classics, nature study, industrial and household arts, hygiene and sanitation, have greatly enlarged the knowledge resources of the elementary school. Drawing, music, and the decorative arts are also winning a large place in the course, while the practical aspects of agriculture, school gardening, commercial geography, and physical training are growing and expanding. In fact the last thirty years have witnessed not only a steadily increasing number of studies but, more important, a surprising improvement in the quality of thought. We have dropped into a habit of boasting of this remarkable progress of the schools and of this improved quality of both cultural and practical knowledge. All the better kinds of knowledge, all the nobler varieties of human experience, past and present, are represented in the school course.

How to make use of the richer content of studies

We hardly know where to look for more worlds to conquer, unless we include in the course the wide range of strictly vocational studies.

A real impoverishment of studies

Now a closer examination of this greatly enlarged program of the schools may surprise us with the discovery that our important school studies have not been enriched, but have been seriously impoverished, by these changes. The outcome of all this apparent progress is the exact opposite of what was intended and confidently expected. We have doubled the number of studies and reduced by half the time devoted to important topics. Many of the new studies are badly organized and meagerly and poorly taught. We have eight or ten separate subjects of study each day where we once had four or five, and little time can be had for preparation, *i.e.* for real study. The lesson periods are necessarily short and the treatment of even important topics is brief and scrappy. We run over a multitude of rich subjects superficially and have little time to study important topics thoroughly. To get all these things even meagerly done, teachers and children are cramped and nervously overstimulated. While the situation in many schools may not be so discouraging as described above, still these are clearly marked tendencies of our times. Our boasted enrichment of instruction turns out after all in some respects to be a delusion. By this overcrowding of studies we are in danger of losing a real grip on studies, *i.e.* our hold upon those superior elements of useful knowledge and refinement and even of character-building which are of chief value. Our curriculum has waxed great, but many boys and girls are kept on the verge of mental confusion and discouragement.

With an undoubted honest zeal for progress and with the best intentions for the enrichment of elementary education, we have pushed rapidly forward in our generous schemes for enlarging the school program and the result is naturally an overaccumulation of knowledge. Now with this embarrassment of riches we find ourselves in the plight of the swimmer whose precious bag of gold is pulling him down, or we are like a heavily laden vessel in a storm. We may have to throw overboard a good share of the cargo to save the ship.

How to save the ship

Our first answer to the question, Is the elementary course of study rich in content? is — Yes. Its richness is so great that it has become a burden and a danger. The surprising bounty and fruitfulness of our elementary studies have now for the first time dawned upon us in full measure, and just as we reach out to seize this richness and appropriate it for children, it slips through our fingers and vanishes. We wake up as from a dream and wonder what has happened. The course of study has been vastly enlarged; but the minds of the children have not been enriched. The results we now witness have happened in the natural order and need not surprise us. We have not yet solved our problem — How to enrich the course of study as a means of enriching the lives of children. We cannot afford to surrender the large knowledge values that have come to us so copiously from literature and stories, from biography and history, from nature study and travel, nor the sound, practical utilities derived from the industrial arts, applied science, and modern English. Nor can we deal profitably with this present multiplicity of subjects, this overaccumulation of studies.

It has been easier to collect these various treasures of

knowledge and to pile them up in the curriculum, than to know what to do with them when they are once collected.

It is easy to introduce new studies

It is an easy thing to introduce a new study, yes, even a half dozen new studies, into the course, but it is difficult beyond all computation to select and organize these new materials with reference to other studies and to children. Thus far we have done little more than collect the raw materials for a course of study and like children making collections, we have gathered much material that we have little or no use for.

In trying to select and group properly the richest thought materials for the elementary curriculum, we are working at one of the most complex and many-sided problems that the human mind can venture upon. It is the task of sifting out and arranging the superior elements of knowledge in all the subjects, with special reference to the growing and assimilating powers of children. To lay out a good plan for any one of a dozen large school studies would be a great achievement, though it be a familiar study like arithmetic or reading. To do this for all studies, old and new, each with a strong individuality, with proper mutual adjustment, is a huge task.

To select and arrange the best is difficult

This rapid accumulation of excessive quantities of knowledge in the school program, and the failure to achieve the results aimed at and expected have brought us, for the moment, to a standstill, and we must size up our whole problem from a new standpoint with a more comprehensive grasp of all the elements involved. How are we to simplify this overcrowded course of study and yet retain its richness, its best content?

In facing this new problem, teachers everywhere by a natural instinct have asked, "What shall we eliminate?" The word *eliminate* has come into vogue in recent years as expressing the means of escape from this educational dilemma. We have indeed made some progress in eliminating nonessentials. More recently another kindred expression, "*minimum essentials*" attempts to express the need of the hour. We venture to suggest that still another phrase expresses the need better yet, *What are the "centers of organization"?* What is the basis for the *constructive organization* of the curriculum? Elimination is a negative term; organization is positive and calls for a center and basis upon which to build. What are the basal projects or constructive ideas in the main studies upon which to collect and organize the knowledge stuff? However, the ideas expressed by elimination and organization are merely different aspects of the same large problem.

A positive basis for organization

The question is no longer whether or not our elementary studies are rich in content, but rather how to get at and utilize in schools the best part of this superior richness. We cannot consent to the loss or abandonment of the substantial enrichment of human knowledge and experience that has come into our school course in recent years. Educationally this enlargement of the field of elementary studies is the greatest achievement of our times and has given the school its central position of influence in the world. We have finally uncovered the deep, abounding sources of knowledge in elementary studies. Let this fact be established once for all as of main importance and that this superior quality of enriching knowledge is present and available for the instruction of children. How to preserve

and make use of this surprising wealth of cultural and practical knowledge, how to reduce the whole to a simple basis by a central organization on a few lines of thought, is our serious problem. We have not yet learned how to give up for the time being a large number of less important things in order to save the best. We could trade off a multitude of minor scrappy topics in order to gain time for handling a few big, rich projects adequately.

It is a question of somewhat radical reorganization, for we have not yet seriously attacked the problem of organization. We have been discussing and trying out elimination without determining beforehand the basis of organization, the few vital centers of purposive thought. We shall not reorganize our complex course of study on the basis of small expedients, by trimming out a little here and a little there. We require something more than a pruning knife. We must undertake a genuine reorganization on the basis of strong, comprehensive, constructive ideas. After completing a survey of children by estimating their abilities and needs — we should turn our attention to the deep knowledge subjects, to the main ideas that lie embedded in the school studies themselves. We should make a closer acquaintance with the original sources of knowledge in school studies as related to life, and on this basis alone we shall strengthen and enlarge our capacity for organization. It is not by skimming the surface of things nor by dealing with mere outlines and minimum essentials and by occasional eliminations that we shall settle the course, but by going down deep into the main roots of important subjects of study. We shall find there the natural centers of organization. This is

Going deeper to the tap roots of knowledge

said with all due respect for children and their needs and for the principles of teaching and their value.

The present demand for this enrichment of the curriculum based on a proper reorganization of studies has behind it the heavy pressure of necessity. For more than a generation this movement to incorporate a full measure of these superior thought materials into the common-school course has been gaining power till it has become irresistible. In spite of this the needed reorganization of studies has not gone far and meets with powerful resistance. It is in fact a colossal undertaking. We still have in the main our old course of study. The conservative tendency to hold fast to old ideas and practice is quite as strong as the urgent demand of the progressives for new studies. In fact we have been adding new studies more rapidly by far than we have been discarding old ones. Most teachers and book-makers in planning courses are conservative. Subjects that once get established in textbooks and in the habits of teachers are slow to disappear. The public school system is a massive structure, embodied in textbooks and curricula and in long prevailing habits of hundreds of thousands of teachers. We may build additions here and there but any serious change in the main structure of the course is a slow process.

Two powerful tendencies to be combined

But free discussion may bring about a coöperative effort between conservatives and progressives. Much ground must be given up on both sides before we can have a simple and reasonable course of study. Teachers should look this important problem squarely in the face. With unprejudiced minds they should estimate openly and fairly the relative values and mutual relation of these two powerful tendencies.

The old course of study in the common schools which prevailed for many years was chiefly formal and instrumental, devoted to a mastery of the symbols which express thought, to formal reading, writing, and spelling, arithmetic, and composition. The right drill upon these formal exercises was believed, also, to have a superior disciplinary value. This fact that elementary studies were mechanical, dealing mainly with arbitrary symbols, established early and deeply the conviction that primary studies were by nature weak in content and to be mastered by sheer memory effort.

The old course was formal

It is not strange that the school became a dry, dull place devoted to drill, and that the theories of education in vogue supported this disciplinary training. But a remarkable change took place with the introduction of this surprising group of enriching, thought-stimulating studies, — story-telling, biography, nature study and excursions, geography and travel, dramatizing of literature, games, construction work, drawing and industrial arts, and physical training. Later still came applied science, health and sanitation, school gardening and agriculture. All these studies fill up and expand the mind with activities, with information, with engrossing ideas, with cultural, emotional, and esthetic experiences. They give equal emphasis to the useful or practical on one side, and to the cultural or ideal on the other side.

The influx of enriching studies

Naturally there was a powerful effort by the schoolmasters to impose the formal drill method of the old school upon the incoming, enriching thought studies, because those old methods were in vogue and familiar to the teachers. When modern science, history, literature, and geography, and even

Skeletonizing the thought studies

the shop activities were first taken up by the schools, they, too, were formalized and stereotyped into a dull recital of facts and were stripped of thought content almost as naked as the three "R's." The school and the teachers were still in the formal stage and all studies were reduced to the same level. It is not strange, therefore, that people at first failed to see in even these new studies any rich and scholarly thought material or deep, inspiring, cultural influences. And yet these new studies had opened up fountains of inexhaustible richness. It was impossible that these copious and enriching streams of thought should fail in the end to break through these formal barriers and display to the world their boundless resources. This event has now happened and we are fully conscious of the unmeasured wealth of knowledge and culture at our free disposal in history, in literature, in the fine arts, in music, in science, and in geography. In fact now that the flood gates have been opened and these refreshing streams of knowledge have poured into the schools through these various channels, we find ourselves swamped with an oversupply of the riches of knowledge.

The swing of the pendulum to thought studies

Enthusiastic teachers of these instructive and enlivening modern subjects have been tempted to turn the tables upon the old formal schoolmasters and demand that we give up these routine methods of teaching, these formal drills and reviews, the lock-step and the memory grind. They have gone so far as to impose the new thought methods upon the old formal studies. We no longer need these mechanical drills and painful, meaningless memorizings, they say. Give the children good inspiring projects and problems and stories and they will pick up the formal

elements of reading and language and spelling. Incidental appropriation of those symbols and technical formalities will take place. It is not our purpose at this point to attempt to show the exact relation between the content and formal studies. It would be tolerant and fair-minded to say that the two classes of studies by nature are so widely different that they require different methods, and it would be a mistake to impose arbitrarily and wholly the plan and method of one group upon the other.

A strong drift toward formalism

In the development of our curriculum in recent years the deeper and stronger thought studies have thus risen to great prominence. But it is easy to spoil these fruitful studies in the handling. The crowding in of many studies has forced us back into formalism. The mere formal memorizing of lonesome facts in geography and history is just as tedious and irksome to children as the memorizing of symbols and alphabets. In reading, writing, spelling, and numbers, the forms and symbols must be mastered as individual facts. But in geography and history it is a mistake to suppose that isolated facts have any significance. Thought studies, like literature and history, differ essentially from the form studies. They center in ideas and not in individual facts, at least not in mere forms. Ideas alone give content to the great thought studies. There has been a mistaken notion among teachers and even among scholars that children should store up a large quantity of these isolated facts in history or geography before they could make a proper beginning in these studies. A few years ago it was supposed even in high schools and colleges that the way to study literature was to learn the name and date of an author and a list of the titles of his works, and so one

after another in tedious succession the dry bones of literature were memorized. We have since learned that the better way is to plunge at once into the original works of writers. Read the best stories and poems. Get directly at the main ideas of the author in the fullness and strength of the author's own presentation. This curious opinion that we must first learn a lot of bare facts about a subject and store them away for a period of years and later allow them to develop into meaning is a mother of blunders in teaching.

The case is perfectly clear in literature. It may become equally clear in geography, history, and science. When this one great fact has become clear, we shall see that the elementary school is the favored place for the full exploitation of the strong content studies. Heretofore we have been dealing too much with individual facts, isolated fragments of these rich subjects. We have been mainly engaged in learning the tables of contents, and not in examining the contents themselves. The time has now come when these deep, inspiring subjects should be opened up in their full richness to children's minds. At this point we strike the hub and center of the whole problem of enriching elementary studies. Can we by any means break loose from the inherited routine of fact-cramming and memorizing which has been clamped even upon the big-thought studies and gain for ourselves the freedom to deal directly and liberally with a few of these large units of study in a realistic and thought-inspiring way? If this conception of study should prevail, we shall be forced to a rigid selection of a few focal units of study in each of the main thought subjects. Each of these large units, once selected, will become the basis

The intensive treatment of a few large teaching units

for an intensive, what we might justly call, masterly, study, unearthing the choicest and richest elements in it. Like a marrow bone each subject must be cracked open so as to reveal the inner fatness.

In the three grades of the primary school, children have approximately mastered the symbols and forms and are ready to plunge into the deeper knowledge subjects. At the beginning of the fourth grade we are prepared to encounter with the children the real problems of the thought studies. Here we should be very wise and circumspect in making our beginnings. (See Chapter IV.) We must have some big, interesting, objective topics, some first-class stories of heroic adventure, of travel, exploration, and pioneer exploit. Literature has a few strong old tales; biography is ready with its Bruces and Boones and Champlains; geography is picturesque, descriptive, and full of big projects; science can display its inventions and discoveries. The temptation is to undertake too many even of these superior tales and projects. One story elaborately and artistically presented is better than many, half done.

Big, fruitful object lessons in intermediate grades

We are now called upon to select more carefully the interesting and lasting thought-centers, the projects around which this copious and inspiring knowledge can be best grouped and organized. We have been groping after these consolidation centers. We have now at hand the full knowledge materials and we lack only a clearer vision of the *centers* of organization. In spite of the recent overcrowded condition of our curriculum, in spite of our strong traditional tendencies toward formal drill, the schools already have made a remarkable advance toward absorbing these instructive materials into

The example of literature

the appropriate centers. In literature, for example, we have gone over, both in theory and practice, to the use of complete stories and poems, English masterpieces as wholes. We are learning also to center attention upon one of these units of study, to make it a rendezvous for important and far-reaching facts and relations. These complete products of our literary chiefs are now distributed through all the grades from the first to the eighth. The stories of Hawthorne, Scott, Grimm, Homer, Irving, Shakespeare, and the Bible have been chosen because they are strong, simple, and significant, containing those germs of thought which are vital and constructive, and suitable. We have found that children's minds spring to meet the occasion and grapple with these world-building ideas. The same stories used one or two generations ago in the college Greek classes are now commonly read or told and dramatized with enthusiasm by children of the third and fourth grades, *e.g.* the tales and adventures of Ulysses, Perseus, Achilles, and Hercules. In the grammar grades, *Evangeline*, *Lady of the Lake*, and *Merchant of Venice*, once used only in normal schools and colleges, are fully exploited before the high school age. Sometimes they are not well taught, but that may be partly due to the fact that we fail to get good teachers.

We now recognize the power of children to think, and we permit them even in primary grades to exercise their brains upon thought material of permanent value. In literature we recognize the privilege and the right of the children to think, and to think on a high level of intellectual, esthetic, and moral truth. We may go one step further and say that if children do not absorb in childhood a large part of the finer cultural influences or sentiments of the best

stories and poems, they will be seriously handicapped in adult life and no later opportunities in college or university are likely to make good the deficiency.

Example of biographical stories

This successful experience in the use of large units of study or classics in literature with children throughout the elementary school suggests that other important thought studies, history, science, and geography, and industrial arts may use to advantage a similar plan of big projects with big-thought material. The schools have been at work selecting and proving up on these important topics. During the last few years historical instruction in the grades has been trying out a series of sturdy biographical narratives which show a strong mental fiber. The lives of notable explorers, inventors, statesmen, and benefactors, when aptly described, exhibit in personal, objective illustration projects and ideas which have shaped progress and built up stable institutions. Such full, biographical stories, more than almost any other influence, impress the minds of children with the real American spirit. In our schools the tendency toward biographical stories is increasingly strong. It furnishes a generous and inspiring content which leads up through representative characters to an appreciation of important historical movements and great leadership.

Applied science

In the natural sciences, an important succession of discoveries exhibits some of the main projects of applied science in objective demonstrations. The remarkable inventions of scientists in a striking fashion lead on to a study and investigation of the deeper problems of science. An adequate introduction to our modern advances in the industries, in commerce, in medicine and in machinery, can be based upon such biographies.

Finally, geography brings upon exhibit an array of big projects by which man has put to his service the forces of nature, *i.e.* national roads, steamship lines, schemes of river regulation, the reconstruction of cities, the drainage of swamps and reclaiming of deserts, and reduction works for gold and copper. Geography abounds in these colossal but simple objective projects that display man's power and ingenuity in controlling and organizing the forces about him, — all as definite, striking object lessons. These big, expansive, world-constructing projects, descriptively elaborated, are now coming more or less into common use in the schools. Though gigantic in dimensions and power, they are simple and by no means beyond the thinking ability of boys and girls. Indeed as big object lessons they just suit the frame of their aspiring minds. They have produced an awakening as to the meaning of large things in the real world that has surprised teachers. Children have a native right to these big projects most worth thinking about and in a form objective and stimulating to the imagination.

Typical projects in geography

History, geography, and science are thus found to be open to inspection for boys and girls, first of all as big, concrete, simple object lessons, full of world information, well worth the knowing, closely identified with the active forces at work about us shaping our world. These are the things for the understanding of which it is worth while to spend time and money in sending our children to school and in keeping them there under wide-awake, well-informed teachers.

Conclusion

In the reorganization of our course of study we must pick out the biggest and best of these large topics which embody the constructive, purposive ideas that are to frame up our

world of knowledge. We may learn how to work out the complete, elaborate treatment of these big, central units and bring them into an orderly sequence.

We are not without experience in this kind of effort. A goodly number of important knowledge units or projects have been developed with a full treatment and have been tried out in classes. Successful efforts have been made, for example, with such units as New York Harbor, the first steamboat on the Ohio and Mississippi, Burgoyne's campaign, the Erie Canal, the Virginia Plantation, the purchase of Louisiana, the Panama Canal, corn production, the cotton plantation, the Pennsylvania Railroad, a Dakota wheat farm, irrigation in the West, the Rhine River, city sanitation.

In this chapter we have been dealing with one of the very distinctive problems of our modern education, namely, how to make use of this new and surprising wealth of knowledge that has opened up. Does it belong to the elementary school? Are children capable of appreciating and enjoying this rich heritage of knowledge and refinement?

Summary of Main Points

Summary

1. The influx of the modern thought studies and the consequent enlargement of the curriculum as a whole has been a great achievement in education.

2. This has led to an overloading and congestion of the school program. The outcome is an actual impoverishment, through condensation, of the important studies, a natural and yet a very disappointing result.

3. The demand of the conservatives for the retention

of the old studies and methods, and the equally strong demand of the progressives for the introduction and steady enlargement of the new studies have made it impossible as yet to reorganize instruction on a simple basis.

4. Literature, history, geography, and science have been pushing to the front with larger and richer contributions. And yet this enrichment can find no proper expression in a condensed and epitomized course of study. Somewhere we must find receptacles large enough and strong enough to contain these superior, vital elements of knowledge.

5. The expanded teaching units, the big topics are these receptacles. The unstinted elaboration of these big teaching units furnishes the only opportunity for gathering in and preserving this indispensable, best content of knowledge.

6. The intensive treatment of big projects is demanded in the interest of children, because it is the only avenue through which this deepening of thought can be brought home to the minds of children. All other plans have somehow failed to bring into use this superior, enlivening thought element. In fact our present short, abridgment methods of teaching these topics saps the life out of studies and leaves them weak in the very thought elements that ought to be strongest.

7. It is the very nature of one of these big units to expand and to gather into itself a full measure of this enriching knowledge. It must be enlarged; it cannot be skeletonized.

8. By allowing one of these big units of study its full, natural growth, by which alone it can be fully understood and mastered by children, we accomplish the two definite results aimed at in instruction — simplification and enrichment of instruction.

CHAPTER IX

LARGER LESSON PLANNING BASED ON PROJECTS

THE first eight chapters of this book bring to the front the large project, the expanded teaching unit, as a standard measure of knowledge which becomes the basis for the teaching process. It is important to get this large conception of the standard teaching unit well grounded in our thought. Its supreme value is confirmed by the fact that on one side it determines the course of study and on the other side the details of method. By referring all the minor details and processes of instruction back to these important centers of organization we get a much broader conception of method in teaching. The process of collecting the abundant resources of knowledge and of combining them into these enlarged units of study may be called the *larger lesson planning*. Until we have broadly mapped out the field of study by selecting these big projects and have marshaled the forces of knowledge around them as centers, we have no proper basis for method in teaching. It seems strange that this important preliminary work has been left out of our calculations and that we have plunged headlong into instruction without it. This failure to lay the foundations of method broad and deep in large teaching units has rendered our discussions of method to a large extent trivial and formal.

Collecting and organizing knowledge around big projects

Deliberate, comprehensive planning and wise forethought on this large scale are peculiarly appropriate to the educator's task. Careful daily planning has been set down by all teachers as a thing of importance, but we now see that broad, deliberate lesson planning strikes deep into the organization of knowledge in its broadest aspects as well as in its narrower daily activities. The discovery of a comprehensive, tangible basis for lesson planning would go far toward solving the most perplexing problems of teaching. As a class we teachers have not taken this matter very seriously. Putting our reliance chiefly upon outline courses of study and upon textbooks, we have not exerted ourselves to master the larger problems of lesson planning, what we have just called the central organization of knowledge at strategic points and the constructive continuity of thought extending through whole studies. We plod along through numerous details with the textbook as our guide, failing to get the broad, organizing surveys of knowledge. In a very narrow sense the one-day lesson may be complete in itself, but in a broader sense it should involve the course of study in wide-reaching relations both longitudinally and crosswise. In the study of sanitary problems like the water supply of cities or a wholesome milk supply from dairies, we should keep our eyes open to many-sided and far-reaching relations of such a subject of study.

This preliminary large organization has been neglected

Teachers are now called upon to accustom themselves to this broader conception of lesson planning, based upon larger units, upon more comprehensive surveys of knowledge, and upon a far deeper scholarship. People in other professions have been practicing this wise foresight.

The architect works for weeks and months on his plans for building before a bit of work has been done in the actual construction. A farmer is now compelled to look ahead three or four years and to plan his crop rotation and stock raising. The merchant forecasts the future, counting the cost and weighing possible contingencies before laying in a stock of goods. Insurance companies work on a long-time statistical schedule. So do all corporations that do business on a large scale. The teacher should not stumble along thoughtlessly from day to day.

Foresight in other professions

The large unit of study becomes thus the natural basis for our efforts at large lesson planning. It furnishes a definite, though flexible, scheme for organizing knowledge. Big, important segments of extensive knowledge, rounded up into full units of thought, furnish the true basis for the teacher's thinking. They should be grasped first in their comprehensive significance by the teacher and later executed in their fullness and detail.

The large unit of study organized around a single, growing idea is the central object of the teacher's serious thought. For its working out in the classroom five or ten or even more lessons may be required. The exact length of time or number of lessons may vary. The whole unit should be planned out in its proper sequence and thought-movement without regard at first to the number of lessons. Even the experienced teacher cannot foretell just how many lessons will be needed to complete a large subject, as the *Vision of Sir Launfal*, or *Enoch Arden*. This, owing to contingencies, is not predictable. If the main subject as a whole is well planned, the succession of individual lessons

The large unit considered first as a whole

will work out satisfactorily. Without this large plan it is a tedious and doubtful task to plan out a week's lessons ahead as separate units. Single lessons are in themselves seldom proper units of thought. To force them into this artificial form is misleading and wasteful of effort. It is better to let the large topic take its natural course and to relieve the teacher from tiresome and useless work.

Big units of study not only furnish a sound, rational basis for lesson planning in the large, but they provide also a liberal scheme of lesson organization freed from the cramping and petty details of over-refinements in method. Big topics offer free scope for large thought-movements, while they leave minor details to the judgment of individual teachers and to the demands of the moment. Teachers frequently make the mistake of painstaking effort in working out many small, daily lesson plans instead of making a large, simple plan for a whole series of lessons. The teacher who, without stopping to survey and master a large topic like the Purchase of Louisiana in 1804, works out the first lesson, the second, the third, and so on for a week or ten days ahead has failed probably to grasp clearly the central idea upon which the whole series of lessons rests. The teacher has had a tedious task and the result is a series of lessons not well organized. Each day's lesson may be a fragment of some larger whole. But the fragments fail to come together to form the large unit. By breaking up knowledge into these unsatisfactory fragments, we lose sight of the organizing idea, and our school instruction becomes a collection of shreds and patches. This is literally true. Instead of a few well-rounded units of study our school books often display a tedious and almost endless

Keep in mind the big unit in its broad aspects

enumeration of mere facts and topics and these are interspersed with short summarizing statements little better than conventional platitudes. It is hard to see how even experienced teachers could plan wisely on the basis of such broken fragments of knowledge. A far more satisfactory and effective method of planning lessons than this hand-to-mouth process is much needed by teachers. The teacher should not be like the mole burrowing in the dark hoping to meet something, but he should have his eyes open looking ahead, and knowing what good things are in store, always conscious of the larger main issue.

Our training schools for teachers are tempted to run to seed in the minutiæ of lesson planning. There is always danger of losing sight of important governing ideas in devotion to these minute methodisms. The big topic with its large sweep of thought, with its comprehensive organization of knowledge materials, at once drops these little things out of sight; for the mind is already filled and prepossessed with a larger view.

The careful planning of a single lesson for one day is a very profitable exercise for young and inexperienced teachers and occasionally for all teachers. Presupposing that a large unit of study has been first well mastered and organized as a whole, the careful planning of one lesson ahead each day is an essential part of the program, especially with teachers in training. This phase of the subject may be better dealt with under the head of minor lesson planning.

In the degree that fragmentary, miscellaneous fact-knowledge wastes time and effort, to that same degree the mastery of large, fully-organized units of study economizes time and increases the value of effort. The big unit of study, in its forward march, brings on a copious and

enriching experience from which to elaborate important conclusions. This progressive working over and assimilation of knowledge into large, rational units of thought gives strength and coherency and retentiveness to what is learned. This not only economizes time in learning, but it trains children into right habits of thinking and of organizing knowledge. A good example is the study of Chicago as a trade center. The same number of lessons spent on one large project, like the Erie Canal, will furnish the child not only with a large quantity of important information, — more facts in history and geography, — but also a deeper insight into the meaning of the facts and beyond that a broad survey of their combined significance.

Economy of organizing into large units

A well-organized unit, completely worked out in its descriptive details, is a godsend to a good teacher who is face to face with the problem of planning a series of profitable lessons for a class. The teacher may not have the time or the resources for gathering the necessary materials; but if the full treatment of such a big unit is already furnished, with one or two evenings' study she may master its content, and on this basis she can from time to time plan out a whole series of instructive lessons lasting two or three weeks. To prepare such a topic from the beginning, by going back to the original sources, might well require all her spare time for two or three months. Big topics like the Virginia Plantation and the Panama Canal are full proofs of the above statements, that is, the time-devouring effort required for the original preparation of such subjects, and again, their great value for a teacher needing well-organized material for immediate use. In using such a well-prepared topic it is not

A godsend to teachers

necessary, therefore, that each day's lesson be worked out beforehand as a separate unit, but the undivided thought-movement of the whole has been fully studied through and planned for the entire series of lessons. As the large subject develops, each day's lesson will bring on its own segment of the whole.

It is not safe to assume that each teacher can collect and organize all this varied knowledge material for herself.

The direct value to teachers of rich, well-organized units

The work of selecting central units of study and of gathering and arranging this copious information into well-organized wholes should have been already accomplished. This difficult and extensive preliminary work may be done beforehand by special experts in various studies. The teacher is now called upon to take this gift of complete, well-ordered knowledge and thoroughly master it for classroom purposes. This is indeed no small task, but it is exactly the thing which every good teacher is glad to undertake because it is the price he must pay in order to become a good teacher. Leaders in education, organizers of school courses, superintendents and supervisors who make demands upon teachers should see to it that the teachers are first of all well supplied with big, rich topics, elaborated and prepared beforehand. To say that every teacher must make all this preliminary preparation for himself is mere talk and worse. No teacher ever has done it, and no teacher ever can, because it is so large and extensive a labor that many well-equipped specialists are needed to accomplish it. Even in normal schools, devoted to the special preparation of teachers in a two-year course, the instructors in special subjects have not been able, as yet, to select and group the suitable materials

A very difficult problem

about the central topics. It is imperatively needed in every good training school for teachers. But the collection and organization of extensive and appropriate source materials around centers of knowledge is a very large and difficult task for the execution of which well-trained and richly stored minds are needed. Extensive libraries are also required.

With such full units of study at hand the class teacher will be able to stock up with a supply of well-digested knowledge on each topic that constitutes a first-class preparation from the standpoint of scholarship. It is a wholly different quality and assortment of knowledge from that found in textbooks. It is deep, rich, concrete, intensive. It is progressively organized and dynamic in its thought processes and it is practical, in close adjustment to life and reality.

Teachers need help and are left in the lurch

By common, universal consent, our textbooks do not hit the mark. They do not supply what is needed. They are condensed and dry and ridiculously inadequate, and yet they are about all the average teacher has. But we say to the teacher, "Skirmish about and get more material." The majority of teachers do not know where to look or what to look for. Why not get busy and supply teachers with this indispensable kind of knowledge? Perhaps it is easier to talk and speculate about what the average teacher ought to know and ought to do. As a final refuge we can fall back upon the trite saying that "the teacher must learn to help himself." But the opportunity to help themselves is now just what the teachers need. The big, well-organized, enriched units of study, furnished to the teacher, supply exactly this opportunity. This is at least true for those who are capable and willing to work.

We are well aware that objection is likely to be raised against supplying teachers with these fully elaborated and organized units of study. We know also that some of these objectors are making poor textbooks which are designed to lay down for the majority of teachers both material and method of instruction. Moreover these textbooks, even the best of them, are known to be relatively meager in content, not one quarter as rich and well developed in content as the central units of study which we have been discussing. We desire, therefore, to give a still added emphasis to the great task of this preliminary selection and organization for the benefit of the teacher.

The large, completed unit of study, expanded into a full treatment, organized on a fundamental line of thought, and enriched with adequate illustration, settles for the teacher, approximately, three important questions:

A threefold strengthening of the teacher's work

First, the general scheme of organization of the whole subject on the basis of its fundamental idea. It sets forth fully the meaning and value of this central idea, and its larger relations to kindred large topics in the course.

Secondly, it has determined beforehand and broadly the choice and arrangement of illustrative, descriptive details necessary to the full illumination of the central idea. Two serious obstacles are thus removed from the teacher's path, one, the difficulty of collecting suitable original data, and the other, the labor of grouping wisely this rich accumulation. This arduous task has been completed before the work of actual teaching begins.

Thirdly, it has decided mainly the extent and range of correlation with interesting topics in other studies. These cross-relations with other school subjects are important

and illuminating. The full significance of the central idea cannot be brought to light without paying regard to these aspects.

The strenuous effort demanded of a teacher or student in the struggle to organize and work out a big unit with full consideration of these three main points will quickly bring to light the difficulty and complexity of the task, for example, a unit of study like the framing of the constitution in 1787, the development of our post office system, the reading of the *Merchant of Venice*, the improvement of navigation on the Mississippi and its tributaries. Even much smaller topics than these just named are big undertakings for the expert organizer, for example, the White Mountains as a summer resort, fruit growing in Florida, Champlain's first exploring trip into New York, the old National Road.

The value to the teacher of such well-organized, completed topics is not merely in this supply of information on specific topics needed in the teacher's special work, but also in the superior standards set up for thinking and for organizing thought materials.

The teacher's masterly knowledge of the big project

The task of fully mastering one of these completed studies, one of these clearly organized and fully elaborated projects, is found to be no small undertaking for the teacher. We have occasionally tried out this plan on a class of mature college students. When held rigidly for a thorough knowledge of one of these prepared topics, such mastery as any teacher would need in handling it, they fall short. They seem to have encountered unheard-of requirements. We are trying to set up higher standards of full, masterly knowledge as a necessary preliminary to teaching.

Now it will be admitted that the complete mastery of the large unit of study by a thorough grasp of the three kinds of knowledge described above is a prime requisite in the teacher's preparation for the classroom work. It demands a distinctive and superior grade of scholarship, a versatile habit of thinking which can grasp large principles and minor details. It requires a sharp eye for facts, and reflective thought which can group the facts into comprehensive relations. Free play of the imagination must be balanced by the opposite quality of accuracy with respect to small matters. The mastery of a big topic such as the Muscle Shoals Project or the use and development of great water powers or the growth of slavery and of the slave interest sets up a high standard of practical, scholarly thinking.

The teacher a leader in large-minded, scholarly thinking

As a guide and leader in thinking processes the teacher needs to be large-minded, appreciative of children, accurate and full in scholarship, discriminating in judgment and entirely practical and well balanced. Such a mastery of his subject should be in the teacher's mind before he begins to outline one lesson or a series of lessons in detail — what we may call minor lesson planning. This well-organized and enriched treatment of a whole central topic is in itself a basal lesson plan, not a formal, skeletonized plan, but a generous and well-arranged collection of lesson material, the real stuff required by the lessons and suitable to the needs of children. Give the subject itself full right of way to unfold in its richness and power to boys and girls and you have a good plan, not formal and empty, but full of content and meaning. The sharp curtailment of big topics with respect to their deeper, fuller content is the

bane of our present system of lesson planning. If outline lesson plans are supposed to take the place of knowledge, of true, rich scholarship, they are a plain fraud. This sort of emptiness should be relentlessly exposed. As teachers we should practice plain honesty in matters of knowledge, and not for a pretense set up outlines. Empty, condensed, abstract statements and barren outlines are the Scylla and Charybdis for teachers to fear and avoid.

Good illustrations needed

If teachers are to be gradually trained into a wise forethought in planning lessons, they should have at hand for inspection and use a goodly number of these well-prepared, completely elaborated units of study as first-class specimens of such completely organized topics. These things are necessary, if teachers are to exercise long-headed wisdom in planning out campaigns of study. On the basis of such a preliminary training, teachers should then learn to work out such topics for themselves from original sources. But they should have time to learn how to do this, and good examples from the hands of more experienced workmen.

How train teachers to the conception of large units?

If good lesson planning depends upon the preceding mastery of big units of study, fully elaborated, how are teachers themselves to be convinced of the full value of such large lesson planning? What more convincing proofs could be given than first-class big projects as examples? Progressive teachers and recent texts show a marked tendency to select big units of study to be fully developed. Concentration upon these vital topics is sound in theory, but common practice runs mainly in the old channels with numerous short-circuited topics. How are teachers to make the transition from the old narrow track, over to

this more liberal scheme of large lesson planning? We need and must have strong, clear-cut demonstrations of big units of study which are plainly workable. Mere theoretic statements of what is desirable no longer satisfy teachers. They must see the ideas harnessed up to school studies, actual topics worked out as demonstrations of complete organization. We have been often told and have repeated the saying for a generation that "Any teacher can work up these topics who has brains and industry." We are now looking for this particular brand of "brains and industry." The time has come for the theorist to step aside for a space and let the doer march to the front. We have a hard problem to work and we shall not solve it with talk, but by a direct frontal attack on the large objects of study. The classroom is an inexorably practical place and wants no shams. It demands real, complete topics, not pretentious and empty outlines.

We need genuine knowledge subjects treated in a masterly way. We may first set ourselves the task of sifting out the school studies and of picking out the central units. This done, we shall then be face to face with the laborious and yet inspiring task of collecting and arranging an abundant and enriching knowledge around these focal points. To lay out the original plan for a big teaching unit in a large way, to collect from reliable, original sources the necessary data, and to shape up this source material into a first-class descriptive treatment is the work of a thoughtful, scholarly, practical organizer. It would be a curious and unaccountable mistake to throw this heavy task back upon mere beginners in the art of teaching. The all-round, finished expert in educational work, at the end of a long, rich experi-

A difficult practical problem

ence, will find himself none too well prepared for this serious and responsible undertaking.

It would be a far-seeing plan to commission some of our ablest teachers, of broad scholarship and ripe experience, and specialists in the different subjects, to give their uninterrupted time and labor to this honorable task. It would be theirs to collect and focus this copious and instructive knowledge upon the central units and to exhibit the results before our eyes, objectively, as it were, in the shape of complete monographs suitable for classroom use. Let this process of selecting and organizing topics continue till we get clearly before us a goodly number of safe and manifest demonstrations of the better modes of organization. For the lack of such examples upon which young teachers can develop their notions of orderly arrangement, we are not making much progress in the art of organization and of lesson planning. On the contrary all our young teachers are being systematically trained on models of organization which are weak in the two fundamentals of sound thinking and good teaching. These models fail first to emphasize the main centers of thought, and secondly, they are markedly deficient in the intensive, enriching elements which give the concrete background to central ideas. Our teachers are following such models as they have in lieu of better which they ought to have. Even a few masterpieces of treatment and organization, if appropriately wrought out for use in the grades, would awaken and hearten teachers with a sense of reality. If we could see a few strong teachers working out such units in a masterly way, others would feel like undertaking it.

Set trained, experienced specialists to work upon these big topics

Two weak spots

In other vocations, requiring trained experts, the leaders are accustomed to accept the challenge to work out and deliver masterpieces of their art. The architect elaborates his plan and supervises the construction of a great building. The surgeon of high repute goes into the operating room and performs a skillful piece of surgery and then discusses it with his students. The lawyer carries his case through all the intricacies and vicissitudes of court procedure. The agricultural expert demonstrates his plan of cultivating corn on the experiment farm. The statesman accepts office and tries out practical schemes of political reform. The poet has even the boldness to publish a new poem to run the gauntlet of the critics. The teacher of poetics seldom does!

Other vocations are more practical

The master among teachers should be one who has acquired the art of producing these complete, well-balanced units of knowledge suitable for use in classrooms. He accepts the challenge also to demonstrate the full treatment of these topics in the classroom. Every teacher should develop this kind of power and the sooner the better. But what is the process of teacher-training through which this ability and expertness are to be acquired? Certainly not by random, haphazard methods, not by imitation of faulty and wrong methods, but by a systematic training in the study and use of the best available illustrations.

Leadership in this art of organizing topics is needed

In training young teachers we should gather together and make a study of completely and thoroughly organized study units. In the mastery, discussion, and use of these, the novices will become familiar with the principles of good organization and of larger lesson planning. On this basis of experi-

Teacher-training on the basis of big units

ence in dealing with such topics they can enter later upon similar efforts at planning and organization. It is a difficult art and one into which the developing teacher grows step by step in his progress toward the ideal.

What we need at present is a coöperative effort among experienced teachers to produce good models of well-organized knowledge and lesson plans, especially with reference to intermediate and grammar grades. We should set up high standards of practical, professional skill expressed in the tangible form of complete monographs on units of study suitable to the character and understanding of children.

Two conclusions may be drawn from this discussion of larger lesson planning.

We shall not get much first-class, large-minded planning of instruction until our knowledge materials are cast into the larger mold of big, comprehensive type-study projects. The reorganization of the knowledge materials of school studies into these masterly units is a task for experienced teachers and ripened scholars.

If children are to become self-reliant thinkers they should have a chance to encounter in each of the important thought studies a series of these large, developing problem-projects. They should take up into their thinking the full energy of one of these purposive ideas which pushes forward against obstacles to a full realization, gathering and organizing abundant and fruitful knowledge in its natural course.

CHAPTER X

LARGE TEACHING UNITS OR PROJECTS A BROAD BASIS FOR INSTRUCTION

A LARGE topic which is a progressive organization of valuable knowledge into a unit of purposive thinking may prove a natural basis for classroom instruction. The whole working out of the Erie Canal Project is such a unit of progressive thinking. We have long needed such standard units of knowledge as a ground for classroom instruction. Industrial and social projects in the active world and great natural phenomena illustrate this. One of the big steel works at Pittsburgh displays a monstrous energy pushing on through a definite, planned process of reducing crude ores, first to pig iron, then to steel ingots, and finally to the special forms used for constructive purposes in bridges, machinery, and shipbuilding. This ongoing process, as a complete, rational unit of effort, supplies the basis for a plan of deliberate study. A cyclonic storm treated as a whole is such a unit. In describing the course of a cyclonic storm as diagramed in the weather maps, we think the atmospheric forces organized into a vast whirling movement which distributes rain, winds, and sunshine over a large area of the continent according to a plan that can be foretold. A story like Theseus, who was endowed with the purpose of slaying the Minotaur and of freeing his own people, has in it such an energetic thought-move-

A standard unit is based on a developing process

ment which works out its purpose in a unit of effort. The life history of a thousand-year pine is such a growing, and, as it were, purposeful, process of combining material forces to produce a typical tree structure. A big topic should have in it this propulsive power of a strong organizing idea and thus can furnish a basal plan for the development of rational thought.

The energy embodied in a growing, purposive idea is often shown in the work of an inventor. His mind becomes absorbed in the struggle to realize his idea. The same is true of an author prepossessed with a purpose which his mind is bent upon realizing. Dickens is said to have been in an absorbed and highly energized mental state while composing his story of the *Christmas Carol*. Every big topic ought to generate in teacher and pupil this progressive impulse to work out and turn into use some idea or principle. Historical projects and many also in geography and science have within them such a natural, powerful impulse, the response to some fundamental need or push. The westward movement of population in the United States, illustrated by the gold seekers in '49, demanded more and more territory and gave an almost settled character to our aggressive westward movement. A subject that develops and organizes its materials in this way provides its own method. The natural growth of the topic creates its own process. The spirit of freedom for self-government in the early colonies was such an aggressive force. Burke calls it a "fierce" spirit for which he was willing to make allowances. It organized action and produced important effects. (See Chapter III.)

This dynamic process is a working unit of effort and produces its own method

The thoughts of teachers and of children are quick to

catch the drift, and move effectively along the track of these impulsive, energetic ideas till they have run their course and have worked out their legitimate and intended results. Such a topic constitutes a working unit of effort exerted along a well-determined course. When these dynamic thought processes are big and comprehensive in their organization of knowledge, they furnish an ideal basis for self-reliant classroom study.

We can estimate the difficulties to be overcome in such an effort and the worth of the results. This is clearly proved in practical projects, such as the building of a railroad, the boring of a mountain tunnel, the planning of a battle, and the building of a dam for the development of a water power. The practical schemes that are worked out by man's ingenuity and labor are of this aggressive, constructive, almost creative, character, furnishing strong, objective illustrations of the very kind of projects that are employing men's activities and satisfying their needs. (See Chapter I.)

The demand for problems

By transferring these outside, pragmatic projects into the school to be used as substantial parts of its course, we satisfy one of the main requirements of our recent pedagogy, the demand for problems, for real, practical problems. It has been claimed that the best kind of thinking is that required in the solution of problems, because this method pits the mind of the student against difficulties. It forces some degree of self-reliance and independence in thinking. The problem calls for a collection of data and for a focusing of attention upon a difficult situation until some mode of escape from the dilemma comes into view, as when Washington escaped from Cornwallis at Trenton. By selecting the projects undertaken by engineers, explorers, and promoters in the industries

or in enterprises for social betterment, the problems of life become the problems of the school. The children are set to thinking these problems through, under life conditions, meeting the difficulties as they arise or have arisen. The plans that were projected and later followed out in constructing the Panama Canal are put before children with sufficient data to make them serve as problems. Children identify themselves with the aims and efforts of the canal builders. In a way, they sense those experiences in their own minds. The adventurous pioneer narratives of early explorers like Fremont, Lewis and Clark, Boone, and Champlain, illustrate many such trying situations where children can feel the real pressure of the hard conditions under which these men struggled and achieved their successes.

The problems of life become the problems of the school

A large, practical undertaking organized on the basis of life experience is found frequently to be not a single problem, but a whole chain of problems. It is a peculiar and striking quality of these projects from life that they exhibit a close succession of trying situations. In life men are always competing and struggling against opposing odds. Problems are in the natural order. Some new and difficult plan is being worked out, like the laying of the Atlantic cable, and it meets with obstacles, and even bitter opposition. As the children follow the struggle and witness the opposing and discouraging facts, the problem becomes acute and real. In such cases the teacher should not be in haste to relieve the tension and to explain the means used to secure a favorable outcome. Let the children struggle with this situation and devise means of escape. They will do stronger thinking and often surprise us with the shrewdness and aptness of their suggestions.

Most historical and scientific movements as well as industrial enterprises are of this problem-setting and problem-solving character. Every new tariff is an effort by Congress to readjust the tariff schedule to the changed conditions and sentiments of the people — a hard and complicated problem. Every incoming legislature attacks new tasks in legislation. New social and economic conditions have arisen and the old problems of taxation and public improvement, of representation and of woman suffrage, must be solved again. In other words, society is all the time setting up new aims and working at their solution. The school may well imitate this experimental way of doing things and work out again the same problems that society has had to deal with before. With this preparation in problem work the children, when grown to men and women, will be the better able to cope with the old problems in their new dress. Every inventor, as Whitney with his cotton gin, or Morse with his telegraph, is trying to devise a new method or machine for doing an important piece of work, that is, he is trying to solve an old problem in a new way. The electric motor, as we have it, is the outcome of a long series of problems or inventions succeeding one another in a natural order. Inventors are problem-setters and problem-solvers.

Historic and economic problems

Children in the schools should have a chance to press up sharply against these problems and at least try their wits at a solution. The facts and conditions which bring on a problem must be clearly presented and then a chance offered and a definite stimulus given to think out a solution. Real life is a world of problems and children may well learn to grapple with just such situations. This is accomplished

The problem is the child's opportunity

not by setting up unreal, artificial problems, foreign to life and reality, but by using the workings of history and the developing projects of real life in commerce, in social and industrial affairs, as examples, and as nearly as feasible in the original form and feature of those very problems.

Such actual projects worked out with fullness give us a duplicate of life and a feeling for the realities of life which constitute a sound basis for further study along the same line. Real life works out all its projects in the concrete. It teaches by example. Then on the basis of such examples the school may go on to build up its broader concepts.

Projects and habits of society as objects of thoughtful study

The large projects in the industrial world are representative. Study one great newspaper plant, including its ways of collecting, printing, and sending out news, and you have the idea and plan upon which all metropolitan newspapers operate. Examine one large department store and you grasp the department store idea which all practice. Study the methods of a large city hotel and hotel life in general is easily interpreted. A short cut to a clear and full understanding of the important habits or ways of doing things in our modern society is obtained through a careful and adequate study of a few main situations. Society performs its chief functions for the world by a few habitual ways of doing things. This is easily demonstrated, — the travel habit on railroads, the reading habit of newspapers and magazines, the dress habit, the three-meals-a-day habit, the church-going habit, the city-building habit, the shipbuilding habit, the political election habit, and the school-going habit. Study a few of these chief habits thoroughly in the concrete, and you understand the ways of modern life.

We were just saying that the best place to begin these studies is life itself, that is, certain big sections or units of life-activity where a typical process is demonstrated. Society is kind enough to teach all her great lessons objectively and typically and the school has only to reconstruct these object lessons on a suitable scale.

Life itself furnishes the units of study

The school by its instruction can also do another very important thing. It can point out other similar objects and demonstrations, that is, it can repeat and enlarge its instructions and make comparisons until the specific lesson grows into a rule or general principle, a truth of wide application. This is known among the pedagogues as inductive-deductive thinking. The school of life teaches by induction by oft repeating its object lessons, and by deduction or constant application. The school, however, while imitating life can do better than life. It can make this process more thoughtful, more reflective, and more comprehensive. It can teach people how to get the higher thought values out of experience. By studying these types taken from everyday experience the school is following the natural order, is strengthening and intensifying the teachings of the real world. It is practicing a strict economy by dealing only with those necessary, fundamental types in which life itself sets the chief store.

The school can expand the teachings of life

The inductive-deductive method of the school finds its basis in the inductive-deductive method of life, and in the derived results which life has accumulated. For these results are not abstractions, but object lessons and ongoing processes, still actively developing and representative of the forces and institutions at work in society. Back of

the present steam engine is the series of inventions by which the steam engine has been brought to its present efficiency. Back of the model scientific dairy are the history and processes by which the dairy has been developed toward perfection. The same is true with all the fundamental processes of our present-day industry and of political life. They have been growing and are still continuously developing. The school should swing its work into these fundamental movements, appropriate them, and put the children in position to keep up and move on with them into the future. This is education in life, through life, for life. The inductive-deductive thought-movement is based on practical grounds of historical development as well as on psychological grounds. Indeed these practical demonstrations are the more convincing.

The method of life becomes the method of the school

The large topic favors *intensive* work upon each important unit of study. It sets a high estimate upon one of these topics and is willing to spend and be spent in bringing it to a complete realization. An elaborate and fruitful treatment of such a topic as the Mississippi River, or the purchase of Louisiana, or the coming of the Puritans to New England, or the growth of a city like New York, is worthy of our fullest effort. To do a thing of this sort well results in what we may call a masterpiece of organized knowledge. The better elements of scholarship and the better modes of thinking come into play. There is nothing superficial or fragmentary in such an effort. It sets up standards of knowledge and of organization of subject matter which are of supreme value. To work out such topics successfully sets up a genuine standard of craftsmanship, and such

The large unit requires an intensive treatment

standards are indispensable if education is to hit the mark instead of shooting at random.

To scatter attention over a multitude of subjects, to get a smattering of this or that, to memorize and soon forget miscellaneous bunches of facts, is to spend the time and go through the motions of teaching but to make little permanent progress. Every complete topic adequately worked out in the class should make a strong and permanent impression, should be a real achievement, known and felt to be such by the children. They are entitled to the best things, but these are not to be had in the loose, helter-skelter fashion. We should learn to centralize the thought of children upon conspicuously important topics, objectively large and clear, intensively rich and fruitful.

Every big unit is a complete achievement

The intensive treatment of a large topic by which it takes on this richer meaning and broader scope of interpretation requires *two stages*. First is the gathering together and organization of the concrete and descriptive materials which give a setting and background to the main idea, as in the study of Washington. A study of the Rhine River requires a picturesque and descriptive treatment, reënforced by photographs or stereographs of castles, ruins, vineyards, fortresses, the Lorelei, the old walled towns, boats and bridges, monuments, mountain slopes, etc. These in turn are made more lively by local legends and stories and history. Enlarged maps of the Rhine shores add much to the definiteness and character of the whole course of the journey along the river. Some particular castle like the Heidelberg Schloss is studied in detail, with the entire plan of the old courts, walls, and adjacent parks and

First, the descriptive stage

grounds, with interior views and the various styles of architecture, the towers, the chapel, the great hall and cooking rooms, the moat and drawbridges, the big wine cask, etc. By these various means we seek to reproduce the detailed experience of the real sightseer, who goes curiously among such places. If the class is studying Yellowstone Park, we expect to feature these picturesque and illustrative phases: geysers, canyons, lakes, hot springs, etc. Likewise in the story of Lewis and Clark in 1804–1805, the exciting narrative of hardship and adventure taken from the diary of the explorers is introduced with pictures and maps. *The Geographical Magazine* with its superb pictures illustrates this one phase of geography study. Many of our textbooks in geography and geographical readers contribute richly to this pictorial mode of illustration. It has been proposed to use moving pictures extensively for just such purposes, and if these pictures are arranged and adapted to the subject matter to be illustrated they will serve well. In making an exhibit of a cattle ranch or a gold mine a similar fullness of description with pictures and drawings or diagrams or maps is required to allow the full meaning to appear. Biographies of explorers, of inventors, of generals, of statesmen are made fruitful and valuable by narrative or anecdote and personal traits and individual experiences.

We may say that every important topic in any subject requires this descriptive background, this fullness of the concrete and objective. The more important the central idea, the more it demands a fine assortment and proper grouping of these attendant circumstances. The king and queen without their court cannot play their part. The idea without its setting is bare and meaningless.

In the second place, a large topic allows time and material for reflection, for thoughtful retrospect and comparison, for a study of causes and results, for noting strong resemblances and contrasts. An important object or central figure must be viewed from many sides or at least from several angles. Mount Shasta presents widely different aspects as seen from different sides. The ocean in repose and the ocean in storm are widely contrasted and both worth seeing. The bigness and importance of a topic are measured by the variety and quality of its important relations, by the amount of quiet thinking it can generate. Even to group and organize the concrete material that belongs to a large topic requires time for thought. A large iron and steel producing factory at Pittsburgh is extensive and complex in its general plan. A description of it involves a series of furnaces and mill processes; a succession of workmen, managers, and inspectors. But when this whole picture is complete the relations of a large central steel plant to the ore mines in Minnesota, and to the land and lake transportation, to the coal mines which supply fuel, and to limestone quarries, supplying lime for the flux of ores, and again, the distribution of the finished steel to building firms in cities, to steel-working machine shops, and to railroads over the country and in foreign lands, — this reflective process leads on and on till the steel works at Pittsburgh are intimately related to commerce, to large house construction, to shipbuilding, to machine shops, to railroads, and to all the industries on a large scale.

Secondly, the reflective stage

This reflective process is a means of developing the basal idea in a big topic till it interprets some phase of industrial life or some historical movement in a comprehensive,

even world-embracing fashion. The steel-producing business is one of the biggest enterprises in modern industrial affairs. To study a large steel plant at Pittsburgh descriptively and then to compare it with other like works at Pittsburgh, at Birmingham, at Gary, at Cleveland, at Chicago, at Baltimore, is to comprehend the bigness and importance of the billion dollar steel trust, as it has been called, and the significance of this business for the whole country. To continue the comparison, later, with steel production in England, in Belgium, or in Germany, is to take a broad world view of this business. To note that less progressive nations like Turkey, China, and Persia are undeveloped in steel production is to set up one of the important standards of progress and efficiency among modern nations, a standard upon which we may measure the present status of nations.

The world-conquering stage

The second important stage in all big topics is this stage of expansion and reflection by which we make extensive comparisons, trace wide-reaching causes, and draw important conclusions for the future. This makes education in the school a thought-developing, world-building process.

In the selection and arrangement of topics for the entire curriculum, we shall find that fundamental ideas develop continuously through the course. A big idea works out and welds together a chain of large units or types. As this series of kindred types develops, comparisons are set up between them. Through such comparisons and reviews a close connection between these kindred topics is organized and maintained until the whole series works itself out as one consistent

A chain of types with continuity of thought

line of thought. The establishment of a connecting linkage between these successive units is the chief means of developing that continuity of thought which we prize so highly but seldom get. This continuous growth of a single important concept through a succession of large types contributes to an extended organization of knowledge throughout the school course. If, for example, the Nile River is being studied, a comparison is made between it and the Mississippi and other familiar American rivers, then with the Rhine, the Danube, and perhaps the Indus and Yangtse and other rivers so as to discover striking likenesses and contrasts. The Nile has great floods which spread out over the flood plain; so has the Mississippi River. The floods along the Mississippi, however, are kept under control by levees so as not to inundate the flood plain. Why this difference, this peculiar contrast? The Nile River rises in great lakes; so does the St. Lawrence. Compare them. The Nile has an extensive delta; so have the Mississippi, the Rhine, and the Ganges, but not the St. Lawrence. Why? The Nile has a series of great cataracts. What has the Mississippi or Missouri or St. Lawrence to compare to this? The Nile is a great historic river. What of the Mississippi, the Rhine, the Hudson, the Tigris and Euphrates, the Indus, and the Yangste? The Nile traverses an arid and desert region; compare it with the Colorado; contrast it with the Amazon. The English have established a great irrigation dam and controlling works at Assuan on the lower Nile; compare this with the irrigation projects on the Snake, the Columbia, the Rio Grande; also compare with the irrigation along the Indus and the Ganges in India, and with the Grand Canal in China.

Such comparison leads to a thoughtful and surprisingly fruitful review. It brings into prominence important facts not thought of before. It impresses the mind with notable contrasts and likenesses and stimulates to an explanation of the causes of differences. Such reviews sift out and organize knowledge. They do more than merely repeat facts. They call for reasons. They work out general notions by discovering similar causes producing like results, and striking differences due to recognizable causes. In other words, such reviews generate thought of the best quality. The old-fashioned static review, which goes over the same facts again and again, and by sheer drill and repetition tries to fix them in memory, is a poor and feeble instrument of study, lacking in thought and wasteful of time and energy, a mind-dulling rather than a thought-producing process.

Organizing reviews

By following this plan of a developing series of types in which all later topics are regularly compared with similar topics previously studied in the same series, we can dispense largely with mere static reviews, with tedious repetitions and drills in which no new ideas appear. Many of our courses of study show a large consumption of time in these dry and unprofitable reviews. Such comparing reviews on the contrary are full of interest and of new interpretations. Facts thus organized do not drop easily from the memory. They have been tied up in too many significant connections with valuable centers of thought to be lost. By this growing and organizing process knowledge becomes a permanent possession. It becomes identified with the very structure and organization of the mind itself. The common complaint that children forget three fourths of what they learn is a sharp

Constructive, organizing reviews

criticism of our whole method of study. If knowledge is gained by a process of growth and organization there is no reason why the important things learned should be forgotten. We naturally and properly forget those facts that have no holding qualities, no permanent interpretative value. It is quite customary to admit that children forget quickly the far greater part of what they so tediously learn. This is not a necessary result if knowledge is properly organized and assimilated as it comes into the mind, if we are constantly looking back and reviewing by thoughtful comparison, if we find a life basis and a life connection for our thoughts. The static reviews that are sometimes provided in history and geography are very blunt instruments of study. They produce a feeble result in a slow and fumbling way, with a forced and tiresome or jaded effort. They accomplish a minimum result with a maximum expenditure of effort, and the results fade away into forgetfulness.

It has been demonstrated in a variety of large topics in history and geography that a vigorous continuity of thought on the basis of big stepping stones of knowledge can be worked out and that experience thus organized becomes the strong and enduring framework of a child's knowledge.

Much has been said about the correlation of studies, their intercommunication, and their mutual support.

Vital relations between studies

The large unit of study which provides for a many-sided and extensive treatment of a topic is inevitably a strong agency in establishing close and numerous relations between studies. Big topics do not respect the artificial boundaries between studies. The roots and branches of every commanding unit spread out into several so-called studies. A good

history story like *Magellan* or *La Salle* is a combination of history, geography, and science and without effort always a fruitful field for language. Four great studies come together and enrich and support one another in such a topic. The biography of a man like Franklin is a still broader and richer combination. Literature, science, history, language, social and industrial projects, statesmanship, all fields of human interest are brought together and closely identified with his personal interests and character.

Practical topics which take firm hold on life have this strong combination of materials, this wide range of real and essential connections. The farmer, the lawyer, the merchant, the banker, the inventor shows this wide reach and variety of interests in his business. The newspaper deals with this universal range and intercommunion of topics. Only the schoolmaster thinks he is free to limit himself narrowly in the treatment of subjects. He sometimes sets up small boundaries between subjects and shuts himself and the children almost within prison walls. Robinson Crusoe is a man who deals with all phases of life, geography and climate, nature and agriculture, the Bible and other literature, savages and civilized. Crusoe is a good study for children because of the wide range of his interests and projects. This is true with Hiawatha, Ulysses, and Gulliver. Big, fruitful topics are far-reaching in their relations and in treating them we should take time to work out and evaluate these connections. Such topics thus gain in breadth and fullness and, so long as the central unity of each topic is maintained, there is little danger of looseness and shallowness. The correlation of studies will there-

Big life topics are always many-sided

fore take good care of itself if we provide the right sort of big topics for study and learn how to treat them in a full, expansive, organizing way.

A standard and oft-recurring criticism of our studies is that they become stereotyped. They tend strongly to grow fixed into a so-called logical outline of facts, a brief summary of essentials or principles expressing the logical conclusions of the adult mind. These are memorized and wrought into the mental habits of children by a process of reviews and drills. The objection to all this from the side of educational critics and reformers is that these matured judgments and summaries of the adult mind do not fit the growing child mind. They may express the final results of the process of education, but they do not fit into the developing process itself. They are not psychological. They are arbitrarily imposed upon the child's mind by an outside authority and they do not fit his way of thinking and his natural mental movements. To put on one of these ideas is like the small boy trying to wear his father's greatcoat. It is grotesque.

Criticism of a formal outline of studies

Our present mode of teaching is particularly exposed to this criticism. In some of our large, well-established city and state systems, a prevailing and strongly marked uniformity of material and method has been worked out and stereotyped. Our present curriculum, overcrowded with studies (new and old), with a wide range and variety of topics in all studies, is forced more and more into an outline, a summary of essentials, a digest. This digest becomes in time a sort of sacred thing which teachers call the "minimum essentials" of a course. Such a static, immobile course loses what elasticity it may originally have and tends

Danger of a static, fixed outline and minimum essentials

strongly to become a fixed routine for both teachers and pupils.

A course of study made up of a few well-selected, large units of subject matter, rich and copious in treatment, cannot be reduced to a mere outline, cannot be compressed into a dull and lifeless summary. Such big, expanded topics, strong in stimulating, concrete thought matter, are not a good basis for mechanical methods. Complete units of study well wrought out are like first-class stories and poems, such as the *King of the Golden River*, the *Pied Piper of Hamelin*, *Robinson Crusoe*, and *Robert Bruce*. They are so real, so vital and intense in their concrete impersonations that there is, fortunately, no way of reducing them to skeleton outlines. A teacher must be unusually dull and stupid who manages to take the life and spirit out of such stories and make them dull and tiresome. It is this stimulating and inspiring quality of big, fruitful topics which we wish to preserve against all encroachment of mechanical and routine methods. The course of study as we actually know it in many schools shows a clear tendency to become stiff and cramped and formal; not so much because teachers and superintendents desire such a result, but because the pressure of numerous studies and a constantly increasing number of topics inevitably force us into a summarizing method.

Big, fruitful topics prevent a narrow, cramping routine

Now as to the freedom and independence of the teacher in dealing with big topics! Such an enriched, fruitful topic developing a strong, central line of thought and spreading out in important cross-connections throws the door wide open for a large freedom of method in the details of teaching. In the first

Big units and freedom in teaching

place, a richly concrete and descriptive knowledge, having valuable connections and correlations with other subjects, tempts strongly to variety and individuality in mode of treatment. A live teacher can hardly handle such a many-sided subject twice in the same way. While the main progress of thought develops along a definite and well-defined route, discussion, question, and individual interpretation are free and many-sided. The one thing the teacher should hold to is the natural, organic growth and sequence of thought, and in big topics this central, growing thought stands out so conspicuously that it commands attention and soon brings the wanderer back from too much side-stepping. The depth and variety of thought in the liberal treatment of a large topic forbids a narrow routine of method.

It is difficult to see how the teacher can lose her freedom and reduce the descriptive parts of one of these interesting, instructive topics to a severe formal drill. Some teachers doubtless have an unusual ability in putting a damper upon interesting and vital topics, but this can hardly be assigned as a reason for dropping out fruitful, instructive, and well-developed topics. Like a story of *Robin Hood*, or *Sinbad the Sailor*, or *Gulliver*, a growing, expanding subject awakens interest and sets the thoughts in motion. Nor can such a topic run the teacher and pupils into a blind hole from which there is no exit. The topic develops more and more into light and freedom, and expands into its full meaning.

In the later expansion of one of these large topics through comparison and wider thought relations both teacher and children are set to thinking on a higher level in an independent way. Compare the delta mouth of the Mississippi

and its shallow, obstructed passages with the broad, deep estuary at the mouth of the St. Lawrence. Why this striking difference in our two great rivers? Such questions cannot be answered through memory drills. They call for an explanation of the causes. They open the door to freedom of thought and originality of treatment, to investigation of facts and to inquiry into larger data. The commerce of the Great Lakes and the St. Lawrence is badly obstructed at the very center by the huge Falls of Niagara, and yet the Mississippi, with no falls and unlimited navigable waters, has much less shipping than the Great Lakes. Why this result? Such comparisons and contrasts set up new trains of thought. They discover and intensify meanings. The reasoning processes involved in these large topics demand deliberation in finding causes and in weighing and measuring values on the basis of definite standards. There is a continuous thoughtful development and ongoing organization of knowledge materials. The discussion of such points develops freedom of thought and a versatile power of readjustment to new facts and conditions. These larger units of instruction, when once fully developed and rounded out, become in time important standards for the measurement of later topics and series of topics. How can these growing topics be handled at all without doing considerable thinking, without developing freedom and self-reliance in teachers?

Reflective thinking on a broad scale

For progressive teachers the large units of study furnish an opportunity. Each year as one of these topics is taught again it can be further modified, elaborated, and enriched. The reference and source books suggested in connection with each big topic open up kindred but new and develop-

ing fields of knowledge for supplementary study. Still other reference books, maps, and illustrative materials can be collected and organized into the treatment of the subject. The chief idea at the basis of the topic is a growing one, operative in the world on a large scale and all the time modifying and enlarging its scope and influence in practical affairs. It is indeed a world topic based on a constructive principle in human experience. The steady pursuit of such growing topics from year to year opens an opportunity for larger freedom and effectiveness. It means professional growth and independence of the best sort. On the other hand, a static course of study, consisting of a given set of facts and formulæ, to be memorized and drilled in, stops growth in the teacher and leads with certainty to a more or less fixed mechanical routine.

The growth of big topics from year to year

The conclusion that may be drawn from this entire discussion is that the large, elaborately organized teaching unit furnishes a sound basis for classroom instruction. It lays down a general plan for a scholarly and efficient treatment of important subjects in full accord with the recognized principles of good teaching. Without some such matured plan for the intensive treatment of the central units of study, instruction scatters and runs to waste or it follows dried-up channels.

Conclusion

For a complete illustration see the *Panama Canal*, in Type Studies and Lesson Plans, published at George Peabody College.

CHAPTER XI

THE SALT RIVER PROJECT AND IRRIGATION

Outline

1. The Rain Belt and the Dry Belt.
2. Government Irrigation and the Law of 1902.
3. The Salt River Valley. Water Supply.
4. The Government Survey. Location of Dam and Lake.
5. A Bird's-eye View of the Valley.
6. Remote Location of the Dam. The Canyon Road.
7. The Preliminary Problems, Cement Mill, Sawmill, and Power Plant.
8. Construction of the Roosevelt Dam.
9. The Granite Reef or Diversion Dam.
10. The Two Large Trunk Canals.
11. How Water Is Brought to the Fields.
12. Truck Farming and Fruit Growing, Alfalfa, etc.
13. Large Expense to Settlers in the First Years.
14. Size and Cost of the Salt River Project.
15. Large Western Rivers Used for Irrigation.
16. The Minnedoka and Twin Falls Projects.
17. The Shoshone and Rio Grande Projects.
18. Salt Lake. The Truckee-Carson Project.
19. A Fundamental Type with Wide Variations.
20. The High Mountains and River Systems.
21. The Demand for Intelligent, Thrifty Settlers.
22. The Reclamation Law of 1902. Need of Government Control.
23. Important Agencies in Developing Irrigation.
24. Irrigation by Pumping from Wells.
25. Irrigating Rice Fields in the Southern States.
26. Future Extent and Importance of Irrigation.
27. Egypt and the Nile Floods. The Assuan Dam.
28. Irrigation in India. China. Peru and Mexico.

Those of us who live in regions of abundant rainfall do not realize that large parts of our own country are either deserts or without sufficient rain to produce crops. In the eastern half of the United States we depend upon the natural rainfall to supply moisture for growing crops. But in the dry western regions water is often drawn from rivers and led by ditches out upon the dry land to make it productive.

Even in the rainy belt we sometimes have dry, hot seasons which scorch the growing crops and do much damage. Our gardeners, to protect themselves against such losses, sometimes water their fields from tanks or reservoirs by means of ditches, or they have overhead pipes which spray the plants in the field. In cities and towns, during hot, dry weather, we often water our lawns and gardens. The farmers, however, whose fields are too large to be watered, try to preserve the moisture in the soil by pulverizing the top layer of earth, by frequent plowing or harrowing, thus preventing evaporation. But in dry or partly desert countries, it is necessary to construct expensive systems of irrigation for watering the land.

In recent years the government of the United States has undertaken a number of great projects for irrigating large tracts of arid land in the West. During previous years many irrigating ditches had been taken out along the rivers of arid states by farmers and by smaller and larger private ditch companies. But there were some great reclamation projects that required such a vast outlay of money that private companies would hardly undertake them. A law was passed by Congress in 1902 by which the government of the United States provided a large sum of money, obtained from the sale of public lands in the

West, which was to be spent in surveys for determining the best sites for irrigation projects and in constructing dams, reservoirs, and ditches for direct irrigation of these lands chosen. A few of these large irrigation schemes have already reached completion, and others are under construction.

One of these, the Salt River Project, we will describe in full.

The Salt River comes down from the slopes of the White Mountains in eastern Arizona, which are about twice as high as those of the same name in New Hampshire. Before joining the Gila River, its valley widens out into a flat, gently sloping plain girt in with mountains. This broadened portion of the valley is very dry and hot, but it has a productive soil, and, when supplied with water in the summer season, produces abundant crops. A little farther down the valley are the cities of Phœnix, the capital, and Tempe. Here, then, is an ideal spot upon which to undertake a plan for irrigation.

The Salt River has also a good water supply. The White Mountains, from which its headwaters spring, are high enough to receive heavy snows in winter brought by the regular moist winds from the Pacific. During the winter season these mountains become covered with snows many feet deep and serve as natural reservoirs. In the warm sun of early spring in this southern climate, the snows melt away and fill the valley with floods. But these floods pass off downstream, and in the middle and late summer little water is to be had. The first great problem was how to store up the flood waters and hold them in check till needed for irrigating the dry lands of the valley in midsummer.

The government engineers of the Reclamation Service had made a careful survey of the Salt River Valley from its sources in the mountains, including its tributary streams, its spring floods, climate, forests, and other resources. They decided as a result of this careful study that the Salt River Valley would be an excellent place to try out their plan of irrigation on a large scale. It would involve the building of an immense dam across the valley, at large expense, for impounding the surplus spring waters. Up the river from Phœnix is the above-mentioned broadened valley. This land slopes back gently toward the mountains on both sides of the river and supplies a large area suitable for irrigation. A survey of this extensive valley revealed about 240,000 acres of good soil which would bear heavy crops if water in sufficient quantity could be secured. In fact, some of this land had been irrigated for many years and was exceedingly productive. Without a supply of water for irrigation, this tract was almost worthless. With an adequate water supply, it would leap into great values and become the home of thousands of thrifty farmers and would even develop villages and towns.

About sixty-two miles up the valley from Phœnix they found a spot where the river had cut a deep gorge through the mountains. At this narrow place the engineers decided to build a dam which would create a lake in the valley above. The upstream portion of the valley, being wider, would permit the formation of a lake twenty-five miles long and from one to two miles wide. Once filled with flood-waters, such a lake would supply a large reserve for purposes of irrigation.

A bird's-eye view of this river valley as furnishing oppor-

tunity for irrigation on a grand scale deserves our careful attention. The lower part of the valley, including the best farm lands, is a hot and dry desert. But a hundred fifty miles to the east, the high mountains serve as a reservoir for collecting the winter snows and spring rains. By means of a large dam in its middle course the spring floods from the mountains could be caught and held in check till the dry summer time. The broad valley of the lower course might receive this refreshment during the long summer season, and the near-by cities of Phœnix and Tempe would supply a good market for the products of this region of gardens and farms.

Such a large enterprise as this for reclaiming arid or desert lands demands wise and experienced forethought, not only in the preliminary survey and plan of the entire project, but also in its energetic and careful execution. It would cost several millions of dollars to work out the plan, and if successful, it will last for hundreds of years, and furnish homes to thousands of families. It was a government enterprise, planned and carried through by expert government engineers of the Reclamation Service.

The largest engineering problem of the whole project was the construction of the Roosevelt Dam across the narrow gorge which was to gather and hold back the waters of the lake. The site of this proposed dam was in the midst of a rugged mountainous region, far removed from roads and very difficult of approach with supplies. Before beginning the work on the dam, it was necessary to construct houses for the workmen, gather tools and supplies, provide men and machinery, and to establish roads and telephone connections with the outside world.

The construction of an easy, substantial road up the

rough mountain valley, connecting Phœnix with the settlement at the dam, was first to be provided. The cities of Phœnix and Tempe raised a subscription of $75,000 for the building of this road. It was laid out through a very difficult mountainous country, along the steep, rocky sides of the river gorges. Its scenery is wild, like that of the great river canyons of Arizona. The Apache Indians from their reservation came in and offered to help in its construction. At first they were not strong and skillful workers. But when well fed, and better trained to this kind of labor, they proved efficient workmen and were paid the same wages as white men.

In the construction of the dam a large amount of cement and concrete material was needed. The cost of hauling this material from Phœnix, after being shipped in from a distance, proved so great that a cement mill was built near the dam, where cement-making material had been found. An immense amount of lumber and wood was required for the scaffolding and cement forms used in the dam construction, and also for bunk-houses and other structures in the village of Roosevelt near the works. On the mountain slopes near by, forests of pine were fortunately growing. Here sawmills were at once erected for supplying wood and lumber. In order to secure an electric plant which would furnish power for the cement mill, for the machines used in dam construction, and for later pumping purposes in the valley below, it was decided to build a canal twenty miles long which would generate 5000 horse power. Twenty miles above Roosevelt, a small dam was built and from this a high-line canal was conducted down the valley. At the Roosevelt Dam the water was dropped through a sloping tunnel to the wheels at the

power house. In this way the water of the river was chiefly used for building the dam which checked the river in its course and caused it to form the lake.

The work of constructing the Roosevelt Dam was begun in the spring of 1905. To insure a safe basis for the foundation, it was necessary to dig down to solid rock and to anchor the ends of the dam deep in the sides of the rocky cliffs. It seemed as if the river had made up its mind to prevent the work. Flood after flood came tearing down the valley, sweeping away the work of the contractor and his men. A heavy flood late in November destroyed all that had been done and did much damage to the newly-built road along the canyon. Later also the contractors were greatly hindered by these unusual and destructive freshets.

During the construction of the dam, the water from above was let through a tunnel cut in the solid rock around the end of the dam. After the construction of the dam also the water was let out from time to time through a tunnel into the main channel of the river, whence it could run down to the second dam forty miles further on, where it was diverted upon the irrigated lands.

The Roosevelt Dam, when completed, was 280 feet high and about 1080 feet along its top, where a wagon road was built. It is in the form of a semicircle arched upward toward the stream for great power of resistance. The dam has a very broad foundation and tapers gradually towards the top. At either end near the rock cliffs are spillways where the flood waters can escape when the lake is overfilled. The dam contains about 340,000 cubic yards of masonry in which 25,000 barrels of cement were used. By constructing its own cement-making mill, the government saved more than $500,000 for the people who

were to use the irrigated lands, since they, in time, were to pay back the costs of construction to the government.

About forty miles below the Roosevelt Dam it was necessary to construct a second dam, called the Granite Reef or Diversion Dam, because the waters collected behind this dam were diverted from the river channel through large canals to the thousands of acres of valley land which was to be irrigated. The Granite Reef Dam is 38 feet high and 1100 feet long, and cost half a million dollars. The water held in reserve in the large lake, forty miles above, can be let out from time to time at the Roosevelt Dam. Thence it flows down the river channel to the diversion dam, where it is diverted to the canals for irrigation. The lake reservoir above the Roosevelt Dam has a capacity for holding in reserve 1,300,000 acre-feet of water. (An acre-foot is the amount of water required to cover an acre of ground a foot deep.) This reservoir at the time it was built was one of the largest artificial reservoirs in the world.

The amount of good land in this tract that can be directly supplied with water from the river is about 160,000 acres, but all together there are some 240,000 acres that might be irrigated, if the supply of water were sufficient. A large ditch starting from the diversion dam on the north side has a flow of 2000 cubic feet per second, and distributes its water through numerous smaller channels to the acreage on the north side of the river. A second ditch corresponding to this, built on the south side, has a flow of 1500 cubic feet per second and distributes its waters to the fields on the south side of the valley. The Verde River also comes in above the diversion dam and the two streams combined are expected to furnish enough water for about

240,000 acres. Good irrigated land, well located, is worth one hundred dollars an acre, or more. Some fruit lands are sold at one thousand dollars an acre. The same quality of land without water may be worth not more than five or six dollars per acre.

The farm lands between the main ditch and the river can be irrigated by drawing the water from the main ditch. The big ditch has an embankment on the lower side through which a sluice box extends. One end of the box is under water in the big ditch, while the other end, somewhat lower, extends beyond the embankment toward the fields. A sliding board or gate at the other end of the boxing can be raised or lowered to control the passage of water. The amount of water and the size of the sluice-box are determined by the number of fields or farms to be irrigated from this outlet. Sometimes these lateral ditches are six or eight feet wide, and a foot or two deep, and again they are small, but a foot or two in breadth.

Because water is scarce and none should be wasted, it is necessary to regulate carefully the amount of water let out and the times of opening and using the lateral ditches. Various devices have been used to measure the quantities of running water. To regulate the use of water, inspectors are appointed under state laws, whose business it is to make regular rounds of inspection of the ditches, and to control the distribution of irrigation waters. The legislatures of the different states have passed many laws regulating the construction of ditches and the water rights of users.

A field is usually supplied with water from a single ditch which enters at the highest point and skirts the upper edge of the field. From this the water is drawn

off in furrows between the rows of potatoes, or fruit trees, or, in the case of wheat or alfalfa, the whole field is flooded till the soil is well soaked. The water is then turned off for a week or two till a second watering is required. A farmer should show great care in taking the levels and slopes of his fields, in laying off his ditches so as to get the best flow of water without wasting it, and without wasting the soils. During the season of cultivation the farmer is busy all day long opening and closing his ditches and regulating the flow of water upon his fields.

Some of the lands which lie beyond the reach of the irrigation ditches will be supplied with water from underground sources reached by wells. The electric power generated at several points in the river above will be used to pump the water from these wells. At the Roosevelt Dam and at several points in the river channel below, good power sites have been selected, and it is estimated that in time there will be 25,000 horse power which can be used partly for pumping and other farm uses, and partly for factories, street cars, etc., in the cities. The same water can be used first to produce electric power and afterwards for irrigation.

The irrigated lands of the Salt River Valley are very fertile. They lie well to the south in a hot climate and can be cultivated the whole year through, yielding two or three crops. The lands are better suited to intensive truck gardening than to cereals. For this reason, small farms of not more than forty acres are as much as one family can well cultivate. The citrous fruits, oranges and lemons, flourish. Alfalfa is the principal crop and yields four or five cuttings a year, and is used for fattening cattle. Ostriches are also raised in large flocks and fed

on alfalfa. Sugar beets are cultivated, also cotton. Corn, wheat, and other cereals can be raised, but not so profitably as fruits and vegetables. The near-by cities naturally furnish a good market for vegetables and garden truck, for fruits and dairy products.

The lands are reserved to actual settlers in small tracts of from forty to eighty acres. The average cost per acre to the government in executing these projects is between forty and fifty dollars. In purchasing a forty-acre farm, therefore, the settler, at $50 an acre, would pay $2000, or $200 a year for ten years. In the Salt River Project the cost has been about $35 per acre, or $1400 for forty acres.

The farmer coming with his family upon a new piece of irrigated land has much labor and expense before the first crop can be raised. The land will need a house, barns for the stock, farm machines and tools, fences, seed for planting, a well and pump, and household equipment. The farmer will require money for family expenses and a store of feed for his cattle, horses, etc., before the first crop can be raised. The land will need to be carefully surveyed to show the slopes and the proper location of irrigating ditches. The first year payments on the land and the local taxes must be met. It has been estimated that a farmer with a family will need between $1500 and $3000 to meet his necessary expenses in getting his farm upon a paying basis during the first two years.

But thousands of such families have found homes on these irrigated lands and by their industry and thrift have made them into profitable farms. About 220,000 acres have been taken up in the Salt River Valley and more than a million dollars' worth of products have been

harvested in a single year. The Salt River improvement has been one of the most important and successful reclamation projects thus far undertaken by the government. The number of acres of tillable land belonging to this project is 240,000, and the cost to the government $9,878,-521. It is expected that this money will be returned to the government by the annual payments and that it can then be applied to new projects in other regions.

The Salt River Project of southern Arizona is one of a large number of projects which are located on streams flowing into the Pacific Ocean. It is a part of the southern Colorado River drainage system. The upper sources of the Colorado River, including the Green River in Wyoming and the Grand River in western Colorado, are also important irrigation streams. They draw their waters from the melting snows of the high Rocky Mountain ridges, where the west winds from the Pacific deposit their moisture in winter and spring. In California the San Joaquin and Sacramento rivers irrigate likewise the great valley of central California. Further north the Klamath and especially the upper streams of the Columbia, coming down from the high Rockies, supply water to many of the broad valleys like those of southern Idaho and eastern Washington.

The Snake River in southern Idaho flows through a broad valley two hundred fifty miles long and from fifty to ninety miles wide. In this valley several large irrigation projects have been successfully carried out, some of them by the United States Government, others by large private companies. This river has its sources in the high Rockies south of Yellowstone Park and the water stored in the mountains later irrigates the valley two and three hundred miles away in southern Idaho.

The Minnedoka Project gets its water from a reservoir formed by a dam in the Snake River. The water above the dam is thus raised to a height sufficient to supply two ditches, the one on the south side supplying 60,000 acres and the one on the north 8000 acres. A striking feature of this project is the construction of three pumping stations rising in a series of thirty feet each by which water is pumped up to levels thirty, sixty, and ninety feet above the south side ditch, thus bringing a series of terraces under irrigation that otherwise could not be supplied by the main ditch.

Just below this on the south side of the Snake River is the famous Twin Falls Project, which was organized and managed by a private company, and by means of a broad, deep ditch from the Snake River supplies many thousands of acres with water. In the midst of this, the beautiful city of Twin Falls has sprung up. The productive volcanic soil of this region yields remarkable crops of grains, alfalfa, fruits, and potatoes. Much farther down the Snake River, on the north side, are other great and successful irrigation projects, at Boise and Payette. This river valley has already developed a large number of successful irrigation schemes, and in the future they will be still further extended. Several states must coöperate in these schemes because the mountain sources and reservoirs are in one state and the irrigation projects in others.

On the other side of the Rockies, just east of Yellowstone Park, is a very interesting and important irrigation project in the valley of the Shoshone River. The water of the river is stored behind a great dam built in a narrow canyon of the Shoshone eight miles above the town of Cody. It is the highest dam of this sort in the world, 328½ feet high, and impounds 456,000 acre-feet. It regu-

lates the discharge of waters of the river by means of a tunnel ten feet in diameter supplied with gates, and by four cast-iron discharge pipes, each five feet in diameter. One hundred thirty thousand acres of irrigable land lie near the storage works, and several hundred thousand acres additional are tributary to this development project. A diversion dam twelve feet in height across the Shoshone River gives a head of water for the irrigation ditches turned off to either side. Four main irrigating canals are provided for, two of them eight miles above Cody, and two others about ten miles below the town. One of those canals before it comes out into the valley is carried through a mountain tunnel three and one half miles in length.

The purpose of the Reclamation Service in dealing with these works is to give as much assistance as possible to settlers. The agents employed by the government in supervising the canals and the distribution of the water to growing crops are fully experienced in this kind of work. A tract for a demonstration farm has been set aside in each project. This is managed by the Reclamation Service for the benefit of the settlers. A demonstration farmer is employed, who has had much experience in such work and is able to aid the settlers in laying out their distribution systems, and in building their canals, also in determining what crops to raise and how and when to apply the water.

The Shoshone River is one of the smaller branches of a tributary of the upper Missouri. All these streams which combine to form the upper Missouri, flowing eastward from the Rocky Mountains, are used for purposes of irrigation, such as the Milk, the Missouri, the Yellowstone, and many smaller branches. Many broad, inter-

montane valleys and the level lands far out into the eastern plains have been made fruitful by distributing the water from these rivers upon the arid fields. Farther south, also, the North and South Forks of the Platte River and the Arkansas, with their numerous tributaries, have been extensively used in irrigating the high plains that stretch eastward from the foothills of the Rocky Mountains. Near Denver on the South Platte and near Pueblo on the Arkansas are extensive irrigation works which have added much to the agricultural wealth of Colorado. For a thousand miles along the eastern slopes of the Rocky Mountains the region once known as dry and almost desert plains has been made productive by irrigation ditches. In springtime the melting snows on the mountains, whose waters have been stored up behind dams in the mountain gorges, have furnished the means of enriching the plains during the summer.

The Rio Grande River, which drains the slopes of the southern Rockies and forms a long boundary between the United States and Mexico, has long been used both by our country and by Mexico for irrigation. Indeed, Mexico complained that the irrigation works in Colorado and New Mexico had used up so much of the water that the Mexicans were not receiving their proper share. After much dispute an agreement was reached with Mexico by which she would accept 60,000 acre-feet each year as full compensation.

After long and full surveys it was determined to locate the great storage dam at Elephant Butte, 120 miles north of El Paso. "This will be one of the largest dams in the world and will make a reservoir 40 miles long, covering 40,000 acres and containing nearly 2,600,000 acre-feet,

or twice the amount of the Roosevelt Reservoir, and nearly two and a half times that of the reservoir produced by the Assuan Dam on the Nile." Diversion dams have been built lower down, and a series of ditches has been laid out for distributing this stored water upon various tracts for many miles along the valley. The products of this warm southern country are similar to those of the Salt River Project in Arizona.

The first Mormon settlers about Salt Lake were among the earliest users of river water for purposes of irrigation in this country. Along the Jordan and Bear rivers, flowing into Salt Lake, they began a system of irrigation that has converted those desert lands into gardens of plenty. The mountains just east of Salt Lake, the Wasatch, and those to the south, are high enough to catch the winter snows and store up moisture for the rivers. In Nevada, which is, like Utah, a part of the Great Basin, the rivers coming down from the mountains furnish waters for extensive projects.

On the eastern slopes of the Sierra Nevada Mountains are two neighboring streams whose waters have been combined to irrigate a tract of more than 200,000 acres. Lake Tahoe, in the mountain edge of California, is the storage basin for the Truckee River. It is a large and beautiful mountain lake whose waters are collected from the snows of the high Sierras. A great engineering plan was worked out by which the waters of the Truckee River, coming down from Lake Tahoe, were carried through an artificial canal across the divide into the channel of the Carson River, which also descends from these mountains. By means of a dam across the Carson Valley, the waters of these two rivers were led out and distributed to the

plains below. Several important mining towns are located near this irrigation belt, so that the products of the farms and gardens will have a local market.

A description of these various and widely separated undertakings of the government Reclamation Service in seventeen different states of the West reveals the fact that the engineers who have planned these projects have been compelled to show marked ingenuity in solving each problem. No two projects are so much alike that they can be worked out on the same plan. The physical conditions, mountains, valleys, rivers, the soil, and climate, have been so variable that each project has been carefully surveyed and the plan developed as based on the peculiar local conditions. And yet there is a general similarity of arid climate, of sources of water supply in the higher mountains, of farm, garden, and orchard products, and of small tracts with intensive farming.

A map study of the mountains and rivers in the western half of the United States will show that the central ranges of the Rocky Mountains are the high regions from which all the longer rivers take their rise, as the Missouri, Platte, and Arkansas on the east, the Rio Grande on the south, and the Colorado and the Columbia on the southwest and the northwest. All these rivers are very important irrigation streams. The Pacific winds moving eastward across the continent drop their rains and snows upon these high mountains and thence the waters descend eastward and westward to fill the rivers and irrigate the valleys and plains. The lesser mountain ranges and those nearer the coast, such as the Sierra Nevada, Cascade, Wasatch, White Mountains, etc., are the sources of smaller rivers, such as the Sacramento, San Joaquin, Klamath, Truckee, Bear,

Jordan, Salt, and Humboldt. When they reach an elevation of ten or twelve thousand feet, the mountains gather the winter snows from the Pacific winds and become natural reservoirs for irrigation streams.

One of the government maps of the Reclamation Service shows that there are twenty-nine of these important irrigation projects distributed through the Rocky Mountain states and through the other states lying in the arid regions farther west. This map shows that all the western states, seventeen in number, including the Dakotas, Kansas, and Texas, are deriving important benefit from the government efforts to reclaim arid lands. Some of these projects are now completed or nearing completion; others are under investigation by the government engineers. These projects contemplate the irrigation of 3,101,450 acres of land, the impounding of waters with a total storage capacity of 13,272,490 acre-feet in the numerous reservoirs either completed or under construction.

It is then the purpose of the United States Government to work out these large irrigation projects for the benefit of the common people and to divide up these irrigated lands into small farms for actual settlers, who pay for their lands and water rights in yearly payments extending through a period of ten years and without interest. In this way the government gets back the money it has spent and later can use it in new projects. It is not permitted that wealthy men should buy up large tracts of land and hold it for speculation. The whole purpose is to help the common man of small means. The government provides for town settlements on these projects, reserves lots for schools and churches, and in some cases provides for the founding of central or consolidated schools.

One of the difficult problems for the Reclamation Service is to secure the settlement on these irrigation projects of men who show superior intelligence, energy, and thrift. Too many men have entered lands on these irrigated tracts who, because of lack of experience or of practical intelligence, or because of lazy or shiftless habits, have proved failures. Men experienced in reclamation service assert that it requires a greater intelligence to cultivate lands by irrigation methods than farms dependent upon natural rainfall. The laying out and care of ditches, and the more intensive culture of smaller farms, seem to require more scientific methods. This is especially true in fruit raising, in truck farming, and in other more specialized forms of culture.

Farming on irrigated lands, where water can be depended on, is reasonably sure of regular returns. The crop production is more directly under man's control, and the sunshine in these regions for ripening and harvesting of crops is more steady and reliable. The productivity of lands under this more intensive culture is greater and it requires much less land to supply a family. It has been claimed that under proper methods of irrigation an acre of land will on the average support one person.

The United States Government came late into the business of irrigation, and gave its attention chiefly to those large projects which were beyond the reach of private capital. The work of the government, however, has greatly stimulated other agencies in the development of irrigation. There are also certain large phases of irrigation that require the general management and control of the central government. The larger rivers pass through or border several states. The main sources of water supply

are often in the mountains of one state, while the use of the water is in other states far distant. The preservation of these water supplies and the building of reservoirs in the mountains should be largely controlled by the national government. The fair distribution of the water supplies among ditch companies in several states can best be managed under national laws and administration. In several river valleys along the border of Canada on the north and of Mexico on the south, international disputes have arisen as to the division and use of the stream waters. The national government must settle by diplomacy all questions which arise in dealing with foreign states.

Several different agencies have been at work on these irrigation projects, including private individuals, smaller and larger groups of coöperating farmers, corporations, and the government. In the year 1909 there were more than 14,000,000 acres under irrigation, distributed as follows (Fortier: *Use of Water in Irrigation*):

Agency.	*Acres.*
Individual and partnership enterprises	6,624,614
Coöperative enterprises	4,643,539
Commercial enterprises	1,809,379
Irrigation districts	528,642
U. S. Reclamation Service	395,646
Carey Act enterprise	288,553
U. S. Indian Service	172,912
	14,463,285

Another method of irrigation worth mentioning in this connection is that by means of wells. In the western part of North Dakota and South Dakota, in Kansas and Nebraska and Texas, wells are bored often 1000 or 1200 feet deep. Abundant underground water for a large farm

is often secured in this way and is sometimes pumped into artificial basins or lakes, which are located and dug out on the higher levels of the farm, whence the water can be carried by ditches to the fields. In Texas about San Antonio and other places this method has been used with marked success. It depends upon abundant supplies of underground water, and is at first quite expensive because of the cost of boring the wells and of equipping them with pumps or windmills. Pumping from wells, as noticed previously, is also used as a secondary means of irrigation on the Salt River Project, and in other places. The water power obtained from rivers is often used for pumping. This plan of irrigation is also followed in southern New Mexico and Arizona, where there are extensive tracts of good dry land for which no river is obtainable. This mode of irrigation is likely to become more and more important, as there are extensive areas in all the western states to which water from rivers cannot be applied, but which are in other respects good for agriculture.

Still another plan of irrigation is followed in the rice fields of the southern states, in the Carolinas, in Louisiana, Texas, and Arkansas. Formerly only swamp lands were used for such purposes, as along the low coastal swamps of the Carolinas. But in the newer states of the Southwest, the prairie land, so called, is used for rice fields. A high ridge of land is thrown up around the fields, and water is pumped up by engines ten or twenty feet from neighboring streams or bayous, or from wells, and the fields are flooded at the proper time for sowing and cultivating the rice. Of course, this kind of irrigation is not due to a dry climate and lack of rainfall, but to the fact that rice grows on flooded lands and requires large quantities

of water which can be definitely controlled at the season for planting.

It has been estimated by experts that the amount of land in the arid belt of the United States that ultimately can be brought under cultivation is nearly forty-five million acres, or about three times as much as at present. With the more improved, intensive cultivation of this area by scientific methods, its productiveness will be largely increased. The extensive work that has already been done in developing the agriculture of the West through irrigation is only the good beginning of a far greater work yet to be done. The total estimated final cost of all the irrigation projects now finished or under way is given as $867,374,186.

Our treatment of the subject of irrigation thus far goes to show that it is a matter of large national significance. It is fundamentally a home-making problem, a means of giving opportunity to tens of thousands of worthy families to establish themselves comfortably on good farms where they can live under wholesome surroundings, with churches and schools, and all the conditions favorable to proper living.

Egypt and India

Later in the study of foreign lands we shall meet with ancient and modern systems of irrigation on a large scale.

Egypt, along the Nile River, illustrates both of these. Egypt has been called the "gift of the Nile." For thousands of years, with its annual overflow, the Nile has brought refreshment and fertility to the narrow flood plain along the course of the river, and to the broad delta region at its mouth. The sources of these floods are the tropical

rains of Central Africa and of the mountains of Abyssinia. From July to September the mighty floods that pour down the Blue Nile, carrying a heavy load of silt, cause the overflow of the lower Nile, overspread the valleys, and deposit their rich silt upon the fields. This yearly contribution of fresh mud gives a permanent fertility to the soil. As the floods retire the crops spring up that give food to Egypt.

The Nile and the Mississippi have curious likenesses and differences. The Mississippi, too, has its great floods, caused chiefly by the overflow of the Ohio, Missouri, and other rivers. But instead of letting its waters out upon the flood plain, men have built levees hundreds of miles along its banks to hold its excess waters in check and to prevent them from flooding the bottom lands. The Mississippi, too, has a broad delta, but it consists of marsh lands not yet brought under control for man's uses. It has been proposed, by a better regulation of the river, to build up the delta lands and make them productive for man's benefit. The Nile flows through a desert with a very narrow and fertile flood plain. The broad Mississippi Valley has sufficient rainfall to make its great fertile plains productive for hundreds of miles back from the river.

In recent years, since England has taken a hand in managing the affairs of Egypt, expensive improvements have been made in the irrigation of the Nile Valley. Thousands of square miles of fertile land along the Nile Valley were not watered, partly because the flood waters were not held back, and partly because the waters were not carried by ditches along the higher levels. At Assuan, about 500 miles up the river from the sea, the British have built the great Assuan Dam. It is constructed of solid masonry, is about 6400 feet long, 120 feet high, 80.4 feet thick at the

base, and 23 feet at the top. Back of this great stone breastwork are stored the waters of the Nile, 1,000,000 acre-feet, not so much as the Roosevelt Dam and lake on the Salt River. In order to prevent the silt from collecting above the dam and filling up the reservoir, 180 sluice-gates allow the heaviest flood waters to pass by, carrying their silt. Later the gates close down and impound the waters. The Assuan Dam, like the Roosevelt Dam, is built for storage purposes. Lower down the Nile at Assiut is a secondary or diversion dam, 48 feet high and 3930 feet long, also supplied with sluice-gates for passing the floods. By means of this diversion dam and the stored waters above Assuan, they have been able to carry the water to 1,600,000 acres not before irrigated, and convert them into fruitful fields of cotton and sugar cane. In all, Egypt has now 6,750,000 acres of irrigated land.

In India, likewise, the British government, by constructing extensive and costly works for irrigating the arid and desert lands, has vastly improved the condition of the native races and guarded against great famines. Some parts of India have excessive rainfall, while other extensive areas are arid or desert. The streams coming down from the Himalayas, like our western rivers, are flooded in spring and early summer, and the flood waters are stored up in numerous reservoirs, behind massive dams, and let out later in the season. In the valley of the Indus, four million acres are irrigated. The Chenab River, a branch of the Indus, has a dam 4000 feet long, from which a great canal starts. The base of the canal is 250 feet wide by 11 feet deep. The main canal is 400 miles long, has 1200 miles of lateral ditches, and has converted 2,000,000 acres from a desert to fruitful fields.

Compare this with the Salt River Project. A strip of country about 1400 miles long through Northern India from Lahore to Calcutta, and about 100 miles wide, is mostly irrigated land. Central and southern India have also extensive irrigation works. In the Madras district thousands of wells are used for irrigation purposes. No other country has spent so much in recent times as India or has brought so many millions of acres under cultivation by the methods of irrigation. In 1901 it was estimated that the total of irrigated lands in India was 53,000,000 acres.

For many centuries China, by her very complex system of great canals and a network of smaller connecting waterways, has provided for the excess waters of her great rivers. By this system of interlacing canals in her lowlands China has provided main avenues of commerce and has likewise supplied water for the irrigation of her rice fields. These waters have also helped to spread fertility by carrying the silt over the fields as in Egypt.

It is a curious and remarkable fact that the four important seats of the ancient empires have been great river valleys where extensive systems of irrigation have been in vogue for centuries — Egypt with the Nile River, famous for ancient cities like Memphis, Cairo, and Alexandria; Mesopotamia with the Tigris and Euphrates, having the ruins of Babylon and Nineveh; India with the Ganges and Indus, the cities like Delhi and Calcutta; China with the Yangtse Kiang and Hoangho and the cities of Shanghai and Peking. It is also in these valleys that the greatest irrigating systems of the world are in use to-day. In Turkey, modern engineers have made surveys for restoring and enlarging the ancient irrigation works of Mesopotamia.

At the time of the discovery of America, the Incas of Peru and the Mexicans had in operation extensive systems of irrigation upon which their wealth and prosperity were built. In ancient and in modern times, agriculture, carried on in arid countries by irrigation, has been one of the chief sources of national wealth.

Problems of the Future

At the close of this discussion of irrigation, we are brought up sharply against new and striking developments. This study has carried us naturally into the midst of national and world problems. Irrigation is just beginning its larger work. The arid districts of our own country and the vast semidesert regions of Africa, Asia, and Australia, when subjected to modern scientific methods, are yielding more and more to human necessities. A few of these large current and future problems may be stated thus:

At present there is a large waste of water in our western schemes of irrigation. There is also more or less waste and disorder due to a conflict of state and national control. How are our water resources and water powers in the western states to be best conserved and administered?

There is a growing use of wells for irrigation. What extent of valuable land can be irrigated by pumping from wells?

In certain productive, irrigated regions of the West valuable products go to waste for lack of suitable transportation. How can this great loss be remedied?

In the rain-belt region of the United States, irrigation is now much used to increase production. How extensive may this become in the future?

How may the flood waters of the Mississippi and of its

tributary streams be controlled and used to the best advantage?

To what extent may the vast arid regions of the Sahara, of central Asia, and of Australia be made productive by irrigation?

The responsibility of government in these great problems of conservation is one of our serious political problems.

References

The Uses of Water in Irrigation. Samuel Fortier. McGraw-Hill Book Co.

Irrigation and Drainage. F. H. King. The Macmillan Co.

Hearings before the Committee on Irrigation. Government Report, 1909.

House Document 204, 1906–1907. 59th Congress. First and Second Session.

House Document 79, 1902. 57th Congress. Second Session.

House Document 86, 1905–1906. 59th Congress. First Session.

Annual Report of Smithsonian Institution. 1915.

Irrigation near Phœnix, Arizona, 1897. Government Pamphlet, No. 2.

American Irrigation Farming. W. H. Olin. A. C. McClurg.

Ninth Annual Report of the Reclamation Service. F. H. Newell.

Water Supply and Irrigation Papers Nos. 70–74, 1902.

CHAPTER XII

METHOD ILLUSTRATED BY THE SALT RIVER PROJECT

BEFORE taking up for discussion the detailed method of handling an organized unit of study we should first examine one of these big units and see what it furnishes us to start with.

The Salt River Irrigation Project, which illustrates such a large unit of study, as presented above, contains some twenty-eight pages of printed matter. Considered as a whole, this unit of study has certain marked characteristics.

1. It is an organized whole, based upon a single, purposeful idea. It is the idea of storing up water in a river and later in the season distributing it over arid land for the purpose of raising profitable crops. Back of this is the idea of furnishing homes for the families of worthy settlers.

2. This unit of study gives a somewhat full, concrete demonstration of the process of actually working out this idea on one large project. The idea itself is a constructive principle which organizes the whole management, and the workers, machines, and processes, into one progressive movement, till the whole purpose is achieved. This idea or purpose has enough energy in it to set all these forces in motion and keep them going till the result is reached. So far as the child or the learner is concerned, it is an ener-

getic thought movement, an effort to grasp and assimilate the steps in this organized enterprise.

3. The idea begins in one objective example, and grows step by step to national proportions and later to a world significance, comprising the great nations of the present and reaching back thousands of years into antiquity.

4. This unit is based on a practical government project which illustrates the organization of forces at work in the world to-day. The whole subject has its setting in practical life. It begins in life conditions and ends with a more definite interpretation of life forces acting in a broad field.

5. Into this center and grouped along the course of this developing process of thought are gathered and organized important knowledge materials, first of all from geography (physical, climatic, agricultural, and commercial), but also from natural science, from mathematics, from history, and from government. A very large amount of important knowledge is brought into close, organic, and significant relation to the central developing idea. This kind of unit-study has been already worked out, organized into a consistent whole, and put into the hands of the teacher for use in the classroom.

Again, before discussing the teacher's method of handling this unit of study in the classroom we may well ask, What mastery of this subject should the teacher have before going into the class at all? This is a searching question and the answer should go to the root of the matter. The knowledge of such a subject for teaching purposes goes deep into the logical framework of the whole as based upon a central organizing idea, and the relation of all the facts to this basal thought. The outline and sequence of main points should stand out clearly, so that the teacher can

handle the subject with assurance before the class without a book. It is certain that the teacher should have a well-digested and ripened knowledge of the subject. This far exceeds what we usually call *thoroughness* because it involves a matured and well-balanced knowledge, a facile power in the use and wider interpretation of fundamental ideas.

Equally important is a correct judgment of these materials as related to a child's needs and interests. We are compelled to presuppose in this case that the organization and plan of treatment for this unit of study are suitable to children.

Are we justified in asserting that until these three important matters are provided for, all discussion of method is premature? First, a full, well-organized, adequate treatment of a complete unit of study; secondly, a matured and masterly knowledge of this unit of study by the teacher for teaching purposes; and thirdly, the subject as organized appropriate to the understanding and interests of children. If our conclusion, as suggested above, is mainly true, a profitable discussion of method in teaching a subject should be based upon well-organized, completely developed units of study. In other words, all rational method is inseparably connected with organized subject matter. Without definite subject matter in mind, or with miscellaneous or ill-organized data, it is impertinent to talk of method. It would be like asking a contractor to build a house without plans or specifications and without determination of the materials to be used.

Organized subject matter a basis for method

It is true that we have had much discussion of methods of teaching subjects without reference to definite lesson

material, but it is quite likely that much time has been wasted in such discussions and that much confusion of mind has been produced among teachers. With such preliminaries out of the way, we are prepared to discuss the method of handling such a developed unit of study as "The Salt River Project and Irrigation."

In regard to *lesson planning* it is a natural conclusion from our previous discussion that one is not prepared to plan or teach the first lesson until the entire unit of study has been effectively mastered. Again, unless the basal organization of the whole unit is clearly in mind, the planning of lessons is formal and fruitless. This deeper, connected thinking, by which we organize all the parts into a well-rounded whole, is necessary or else our so-called method breaks up into fragments and peters out. Lesson planning will almost take care of itself, if we will organize rich and copious material into a strong sequence of developing thought. If we can get a dynamic thought-movement into a big, enriching subject that grows into an important whole, lesson planning will be easy.

Complete mastery of the entire topic

The treatment of one of these big units of study breaks up easily into *two big sections* or halves. First is the revelation of the main idea in a striking objective manifestation. The Salt River Project is the concrete working out and demonstration of the idea by means of vivid, detailed description, reënforced with maps and pictures. It involves difficult problems also, and more or less painful struggles to overcome obstructions and obstacles: the arduous road-building, the dam construction broken down and swept away by unexpected floods, the installing of water powers, the need

Two stages in the treatment

of a diversion dam, the survey of the main ditches and the taking out of small ditches to irrigate particular patches, or the hardships of the settlers waiting for the first crops.

The second stage in a big unit is the broadening out of the subject so as to include the peculiar features and difficulties of other irrigation projects, with back references and comparisons to the Salt River Project. The idea of irrigation takes on new phases in new and quite different localities. New problems must be met and solved. Each project is a strange and difficult enterprise even for experienced and skillful engineers. And yet, when completed, they all serve one and the same main purpose. This idea grows and grows in the valleys of great western rivers till it becomes a powerful means for the development of seventeen great western states. Not only the national government but large private companies and thousands of farmers along western rivers have been taking out ditches and are irrigating smaller and larger farms, till in the aggregate 14,000,000 acres in the West are under cultivation, and twice as many more will gradually be brought under the irrigation ditch.

The main idea has in it this wonderful power of growth, this expansive energy which so well expresses the character of the westward moving pioneers, in overcoming the forces of nature and making them subject to man's uses. By its onward movement this unit of study expands into a national importance. We may now compare irrigation in the West with that in the rice swamps and prairie fields of the Gulf States from the Carolinas to Texas.

Here our unit of study as an American topic naturally ends. But it almost forces itself upon our attention as a world topic in other lands.

A third section is added as a separate unit of study, dealing with irrigation in Egypt, showing how such a topic, or its basal idea, expands and overflows into other continents. The Nile River as an irrigation stream is a conspicuous type-study of river irrigation, extending through thousands of years, and recently growing into still greater importance by the application of modern scientific methods. India, China, and Mesopotamia are naturally drawn into comparison with Egypt and with our own systems in the Great West. All this merely shows the scope and developing power of a constructive, organizing idea.

Such a unit of study is naturally a series of problems. The original project itself is a great problem which naturally breaks up into minor problems, and these the engineers were compelled to meet in their natural order. This necessary order we follow, encountering the same difficulties they met, and struggling with them. The necessary causes and reasons for action are apparent. There is an inexorable necessity that holds us to the actual conditions. These are not made up, fictitious problems. They bring a child as near to life and its real conditions as it is possible to get him in the schoolroom. For this reason it is necessary to get as deep as possible into the facts, into whole nests of facts which furnish the hard conditions to a problem.

Problems in a natural order

The teacher should see to it that somewhere the problem, with its needed environment of facts, is placed clearly before the children. Oftentimes the conditions of the problem should be fully and vividly presented by the teacher or the book. Then the children should be given a chance to struggle with it and work out some sort of rational solution. Sharp and definite thinking may be re-

quired to show, for example, how a water power was constructed, how the sluice-gates would let out the flood waters, how the diversion dam was built and connected with the two big canals, how water is drawn from the big canals to spread upon the fields, how electric power could be generated and later distributed to the farms for pumping purposes. A comparison of big projects will reveal how the same problem was solved differently according to local necessities.

In class instruction the mode of asking questions is much in dispute. How and what questions to ask is often bruited.

Questions based on previous organization

It may be said that thorough organization of knowledge is a good basis for questioning. A project that opens into a succession of problems is just a series of main questions, for each problem may be put in the form of a question. Until the knowledge materials of a subject have been grouped and arranged into an orderly sequence of main points, it is impossible to select and locate the main questions. On the other hand, it is fruitless to muddle children with questions on a subject about which the teacher has only miscellaneous or badly assorted knowledge.

The key to the situation in questioning lies in determining the growth of the central idea in its main stages. An important question is one that plays directly into this critical argument. In the Salt River Project, for example, Why was this river selected as suitable for a big irrigation project? In what relation do the White Mountains stand to the main purpose? Why is it necessary to have two dams, and what is the special function of each? Why did it seem advisable to construct a cement-producing mill? Explain the reason for Phœnix and Tempe contributing $75,000 to the construction of a road up the canyon to

the Roosevelt Dam. Where were the best points to establish power plants, and why? How is one of the big ditches, which is drawn from the diversion dam, laid out so as to irrigate the largest acreage? After the farmers have raised good crops of fruits, vegetables, and alfalfa, how can they best dispose of these products? Why does the government limit to forty or eighty acres the amount of land granted to one person? Why does the Reclamation Service establish a demonstration farm upon each of these projects?

A great amount of careless and useless questioning can be avoided by any teacher who will completely master the organization of his topic before beginning the teaching of it.

Another mode of wasting time with questions is due to a wrong method of developing topics. Teachers are afraid to tell children anything, and show a strong tendency to develop the facts by questioning. But many of the mere facts refuse to be developed even by very shrewd questions. Many of the important descriptive facts must be directly presented by the teacher or by the book or by some reference. They are the necessary conditions upon which the problems are based and the problems as such cannot be understood at all until the facts are known. In such cases the skill of the teacher rests in a clear and able presentation of the facts. He should be an expert in language description, in map sketching, in making blackboard diagrams, in the selection and use of pictures, and in other modes of graphic illustration. His professional skill may be shown in inventive devices and in the varied use of maps and of objective illustrations.

On the other hand, the teacher can overdo this stunt

of illustration. He should know when to stop and to throw back the whole burden of thought upon the children. After all, this information poured out upon the children so freely is merely designed to set them to reasoning, to working out thought problems on the basis of the facts given. It is quite as important to know when to withhold facts — to ask a question — as to know when facts should be directly furnished.

Interpretations

In the second stage in the treatment of large units of instruction, the main thought is worked out and demonstrated in an enlarged way upon a group or series of new situations. A rapid interpretation of these new problems on the basis of the main idea, already fully explained, is demanded. The idea of irrigation, fully presented in the Salt River Project, speedily interprets the plan and execution of other similar projects in Idaho, Nevada, Wyoming, or Texas. And yet these new situations bring out conditions which demand serious thought and a careful adjustment to new and strange locations. Comparisons are made which show striking contrasts and novel applications of a principle. In the Minnedoka Project but one dam is used for storage and for diverting the water. In others, two or more dams are used. In the Salt River Project the irrigated land is in one compact body, in the Rio Grande Project it is distributed in a long series of tracts scattered up and down the river for many miles. In Wyoming the storage reservoirs are far up in the mountains, while the diversion dam and ditches are in another state far distant. In some rivers there are spasmodic floods, in others the flow is somewhat regular. In the states near the Canadian border the seasons are short and the products chiefly hay, potatoes, and cereals, while

in southern California and Arizona semitropical fruits are raised and the growing season lasts the twelve months through.

This second stage of treatment calls for a large amount of comparative thinking, a certain versatility of thought for explaining new and novel situations. This demands practical judgment, because we are dealing with actual conditions, not theoretical or hypothetical cases. Under these conditions the main idea in the larger unit develops and expands until it takes in a great stretch and variety of country. It becomes a principle of wide interpretation explaining and organizing hundreds of important geographical facts. This training into flexibility of thought is the cultivation of an important mental attitude. The knowledge presented in our textbooks is almost purely *static*, and is so thought of by both teacher and pupil. But vital, growing ideas are always variable, *never static*. They are all the time at work reconstructing the world and changing the old order. If children are so unfortunate as to get the notion that knowledge is fixed and invariable, like the facts of the multiplication table, they get a complete misconception of the world and of the forces that are shaping practical activity in the world. The growth and modification of ideas, the readjustment to new conditions, the application of thought to fresh and difficult problems, constitute the education which fits children for the modern world. The world is no longer in the static, Chinese epoch. It is changing with a rapidity that keeps every thoughtful individual on the jump and sometimes leaves even progressive and versatile people far in the rear.

Flexibility in thinking

In treating big units of study the use of comparison

is a frequent and valuable instrument of instruction. In truth, comparison is a helpful factor in sifting and weighing out knowledge values and in grouping together facts which will grow into strong centers of influence. The presentation of new projects in irrigation, like the Minnedoka and Shoshone tracts, and their comparison with the Salt River Project gives the main idea of irrigation a chance to develop and show its importance in the West. On the stepping stones furnished by comparisons the whole unit develops its importance. The original project, that of the Salt River, reveals more and more its *typical* character and becomes a well-defined standard or unit of measure with which to estimate all irrigation schemes. The natural inductive-deductive movement by which these comparisons are worked out is a basal method of organizing knowledge. It is a kind of progressive, systematic organization that continues through the whole course of study. For such an idea as that of irrigation will continue its developing, constructive influence through all the continents.

Comparisons develop the type

In reality comparisons become stronger and more significant as we advance in the course. The ancient and modern methods of irrigation in Egypt, India, and China will be brought successively into comparison with our methods in Arizona. The ancient systems and the modern scientific methods come together and throw a strong light, each upon the other. Such comparisons of old and new, and of the methods of different countries and ages, give a reflective quality to review studies which the static, drill review knows nothing of. We could well afford to dispense with the dull routine of review drill if we could set the children to thinking, comparing and building up

their concepts on the basis of fundamental types, which form a concrete basis of comparison extending through the whole course of study. All the big units of study furnish, in the fundamental typical idea at the center of each, a good basis for review by comparison. Herein lies a clear economy of labor in learning and a firmer, more permanent organization of knowledge.

We need not be frightened that a big unit of instruction like the Salt River Project reaches out into the world and draws into its organization much important material not only from the chief phases of geography (physiography, climate, agriculture, and markets), but also valuable data from science and history. Arithmetic has also rich picking in the statistical data and measurements, including engineering materials and costs, land areas, products, etc. This is only another phase of the strength of an organizing idea, growing and expanding through the grades and drawing under its influence what naturally belongs to it. As to method, there is nothing artificial in this way of handling a topic. It is the natural, legitimate growth of thought, inherent in the very subject.

Correlations are natural

As said before, such a topic is practical and real, springing out of life and interpreting important forces at work in the world. By understanding big projects as they are developing in the world, we discover at the end of our study that the next problems are directly before us. In short, the future contains the solution of all these problems that are developing in the present life of the people. Our method of handling these topics leads us directly into the future with the kind of knowledge that enables us to interpret its difficulties.

In our discussion thus far, we have had chiefly in mind the teacher and his need of well-organized knowledge. This sets up a high standard for teachers. It is very difficult for teachers to image clearly and definitely the succession of engineering problems involved in a project like that of the Salt River. Although they have read this very subject through with some care, a sharper test upon the essential points will reveal the fact that they have not thought out the situations clearly and completely. This is probably due to the fact that they have never been trained to construct complete imagery in such projects and not because they are short in mental ability.

Teachers fail to image clearly

The same test of thoroughness needs to be applied to teachers in the reflective and comparative studies proposed in the second stage of this larger topic. Teachers themselves have not formed this habit of making definite and specific comparisons, of measuring and estimating different projects on a standard once clearly set up. They have not been accustomed to trace the growth of an idea through a series of variations bringing to light a fundamental process which goes on interpreting an ever-widening range of phenomena.

They fail also in reflective thinking

We have been repeatedly emphasizing these things as the basis of the teacher's efficiency. We now turn to the school child and make the startling statement that we are preparing to direct him into this same kind of effective imaging and comparative thinking. Indeed the reason we desire the teacher to do such excellent thinking is that we know the child can do it if he is only directed properly by a thinking teacher. What is to be our plan, therefore, of engaging the minds of children with projects like that of the Salt

Going down into big topics with children

River? First, of course, is to take up this project seriously with children in its whole climatic and physical environment, to survey the problem with the engineers, and to see where and how to begin the work. We are going right down into the project itself to deal with it in its actual facts and relations. The children are soon alert, heart and soul, and are reaching down into the essential meanings of the subject. It is curious to observe that the very thing which we regarded as the chief difficulty — the ability to image these complex situations — does not cause the children serious trouble. They are scarcely as yet out of the imaging state of childhood. They dote upon the objective and concrete. They are just ready to develop their concrete thinking into larger schemes — the bigger object lessons we have talked about. It is easier and more natural for children to do this kind of thinking and concrete imaging than for adults. Teachers have gotten out of the habit of doing this, for it requires an effort and it goes a little against the grain. Besides, it demands a good measure of real knowledge! There are some serious difficulties to be met by real thought-effort on the part of the children, and we have no desire to soften the rigor and strain of this effort. In fact we are here with the children to struggle with these situations and keep at them till we work them out. It is an honest effort on the part of all concerned to go to the bottom of an interesting subject.

We must admit, however, that some questions will come up that are too difficult for children or for us as teachers to try to explain. The turbine wheel, the transformer, the nature of electrical energy, may properly arouse the curiosity of children and may be best referred to later high school and college studies

Some unanswerable questions

for complete explanation. It is the nature of all big topics to run into some difficulties that cannot be solved at present. This is in fact a good method of awakening a beginning interest in later and larger studies.

The instructor may be helpful to children at times by refreshing their minds and by suggesting familiar experiences that will apply to the difficulty at hand. The cement work which children have seen done in bridge abutments or in concrete foundations may be just the thing needed in interpreting the cement work on the dam. It may be advisable to visit some local shop or piece of constructive work to secure the data necessary to interpret the Roosevelt Project. Sometimes it is profitable to make a map or diagram on the blackboard and discuss it fully in class in order to clear up a difficult part of the construction. Such was the case in one class in trying to explain the high-line ditch or canal that was dug twenty miles long to supply a water power for the construction of the dam. One of the best things any teacher can do is to compel children to use their former experience or knowledge in interpreting new topics. Oftentimes they are surprisingly apt in the use of such personal experiences. Let the children also be free to use the blackboard as a means of explaining and expressing their own ideas and interpretations of the subject. As a result of the teacher's example, they quickly and easily fall into this excellent habit. Give a boy or girl who desires it a chance to make a full, unhindered explanation of a difficult point. Be not overhasty in condemning a child's interpretation. Give him a fair hearing and correct his mistake and go on.

Stirring up and using past experiences

The problems involved in these large projects are more interesting and stimulating to the minds of children than the problems of arithmetic, because they are clearly objective and practical and lie directly in the essential line of thought. They are the necessary steps for reaching conclusions that we are after. They are more practical than arithmetic because they are not so exact and easily determinable. There are more contingencies and uncertainties, just such as we meet in the difficulties of daily life. Unexpected emergencies, such as sudden floods and accidents to machinery, arise, or the rock foundation is insecure and must be reënforced, or a cave-in occurs which demands special, inventive readjustment. This kind of thinking puts children into the real struggle of life and no wonder it engages their full powers. There is no uncommon or excessive difficulty in thinking out such problems, if only we furnish enough concrete data, the real conditions and facts. Here again the teacher needs knowledge and plenty of it and this is a very serious difficulty. The dynamic thought-movement through a series of problems toward a fought-for goal is the essential thing, the motivated energy.

These problems better than those of arithmetic

The second stage of comparisons, of combined aggressive and reflective thinking, rests back upon the first stage as a necessary foundation. We cannot make comparisons that amount to anything without a well-established, clearly defined unit of measure upon which to base the comparison. It is nonsense to talk of comparing irrigation projects and of developing a comprehensive view of government and of private irrigation until we have a clear and full concep-

The unit of measure must be clearly defined

tion of at least one great project. The big, well-developed *object lesson*, which for all the future stands out as a standard unit of comparison, is the first inevitable need of the child if he is to be held to real thinking. On this basis of a real, tangible unit of measure, he can do the thinking just as well as you or I, and without this basis the teacher himself can do no real thinking and is thrown back upon empty, hypocritical phrases.

How do we know that children in intermediate and grammar grades can do this kind of progressive thinking?

Reasons why children can think

First, because we have traveled over this road with children and have seen others traveling the same route, and secondly, because it is, in its nature, a much easier road to travel with children than the abstract road usually taken. Thinking on the basis of large, concrete object lessons as standards of measure is natural and easy. It is the effort and pretense of doing real thinking without this basis which makes study dull and hard and essentially discouraging. Be it remembered that we are dealing with the selfsame topics in common use in our textbooks. The main difference is that we are making these very topics richly intelligible to children.

A third reason for crediting the children with this ability to think in larger terms is that this *big object lesson* puts into children's hands an instrument of thought with which they love to operate. It is a discovered talent which they can put to service. Like the parable of the talent, it is a treasure not to be hidden in the ground. One of the big things we can do for a child is to put him in possession of one of these ideas in the form of a great object lesson and then allow him to test it out here and there on new situa-

tions, and test it again and again until he grows into a habit of applying his knowledge. For the world is all the while opening up new avenues through which these same ideas operate.

Having discussed these more fundamental questions of classroom method, we turn now to a few important points with which the practical schoolmaster must always deal:

1. In the assignment of a lesson in the book or in a study pamphlet, the children should be held firmly to the mastery and reproduction of the work assigned. It is presupposed that the assignment has been reasonable and clearly stated. In the following class discussions, also, we should penetrate deeply into the subject and demand clear and complete imaging. We set up here the same standards of clear thinking for children which we have previously emphasized for teachers. Careless and slipshod statements and loose thinking are not to be endured. There should be a kindly but firm insistence upon high standards.

Children held to a mastery of work assigned

2. In this connection and as an offset to any undue severity, freedom of expression should be allowed children. Freedom to draw and sketch and diagram at the blackboard have been mentioned already. They should also be allowed freedom and originality of speech. Let them cultivate a picturesque and figurative and descriptive style in speaking. Children are young and imaginative and extravagant in speech and these big object lessons call for much freedom and originality of constructive imagination. Big projects in geography, big conceptions and inventions in science, and big historic movements are much like literature in their demand upon invention and imaginative picturing.

Encourage freedom of expression

Sharp, vigorous, picturesque language, striking phrases, and apt and even amusing descriptions are especially appropriate. Give children great freedom in this respect.

3. Some prompt drill exercises can be thrown in nearly every day. These large topics, such as the Roosevelt Project, develop into important series of irrigation projects, of rivers, or of mountains. These should be fixed in memory by drills, sometimes oral, sometimes written. A single important idea underlies such a series and the drill emphasizes and gives importance to this idea. As a big topic develops through comparisons, a chain of important cities or of physiographic regions or of industrial enterprises develops into a national or world significance, and this natural sequence of headings is worth fixing in mind.

Drill upon series

4. A big topic is a natural rendezvous for the collection of pictures, maps, and reference materials. These should not be piled up in a confused mass, but sifted and arranged, and their value as contributions to the main topic clearly brought out. Children who have the time and ability may be appointed to report on some of the reference topics, and should be held to a clear and adequate statement of such a contribution. The collection, the orderly grouping of such interesting and helpful material around the main topic has important merits. It sets the children to work in definite efforts of their own to enlarge and enrich the subject. It breaks up the monotony of mere textbook and classroom work. It is the beginning of a habit of collecting and organizing knowledge materials around important thought centers, a habit of great value for a lifetime. It even leads sometimes to original constructive efforts to devise machines, or sand

Making collections

maps, or models for the more definite illustration of important ideas. It socializes class work by mutually helpful contributions.

5. A copiously developing topic like irrigation, which opens out widely into geographical and historical fields, offers a number of excellent themes for composition. Being so fruitful in knowledge, it supplies the first essential requirement, — a meaty subject to deal with, deserving a worthy treatment.

Suitable themes for composition

Such themes as the following are easily suggested:

1. The future of irrigation in the United States.

2. How to secure greater economies in the use of irrigation water.

3. Ancient systems of irrigation in Egypt and China.

4. Possibilities for irrigation in the Sahara and the great deserts of Asia.

5. The extension of irrigation in regions of natural rainfall.

6. The superiority of irrigation as a method of agriculture.

7. Law-making and water rights and the relation of irrigation to state governments and to the national government.

8. Irrigation by wells and pumping.

9. The importance of water powers connected with irrigation projects.

Good reference materials are available for the study and treatment of such topics. A list of such references is given on p. 215.

In preparing and writing on these topics children should be encouraged into freedom and independence in the organization and handling of the subjects.

It is not the least of the values of these big, richly developing units of study that they open up such profitable source materials for original composition.

6. Before ending and laying aside such a topic as irrigation, a final review — test or examination — may profitably be given to the children. Such a test has marked advantages both for the teacher and children. It might be well, when possible, for the principal or some other qualified teacher to give this test. It would be equally valuable to the principal by bringing him into definite relation to the work being done in the school. The regular teacher would have his eyes opened to the weak and strong points in his own teaching. In subjects which children have gone into with zeal and with real effort they will thoroughly enjoy this opportunity to give an account of their proficiency in mastering a large and interesting subject. It is a great opportunity indeed to witness the richness of thought and superior language power gained by children.

A final review test

Two points should be kept clearly in mind:

1. The basal organization of the knowledge material requiring sound thought and right sequence.

2. Clearness and accuracy in regard to facts and entire situations, *i.e.* complete imagery.

Such a test gives completeness to the whole undertaking as a worthy and responsible achievement.

CHAPTER XIII

CLASSROOM METHOD BASED ON PROJECTS

We wish now to go deeper into matters of classroom method. The first question is: How are children to come into contact with the knowledge materials in these big projects? Or putting it in another way: How does knowledge of this sort best unfold itself to children's active minds? We will presuppose that we have a well-organized unit of study suitable to the needs and capacity of the children.

One way provides that the teacher present the whole subject by word of mouth, in the best fashion at his command. Another way is for the child to read it from a book and appropriate it the best way he can. In either case the whole subject may be reproduced later and discussed in the class. Or these two ways may be combined. The teacher may introduce the subject, open up the field of thought, and arouse the interest of the children in one or more initial problems. He then assigns a lesson in the book and calls attention perhaps to one or two problems or difficulties that will arise. At the next lesson, the whole matter is reproduced and discussed in the class.

These are sometimes called the lecture method and the textbook method, and some critics object to both as modes of appropriating knowledge. And yet, in the hands of good teachers, these plans produce excellent results. This conclusion is based on the condition that

teachers are careful in the assignment of lessons and have some skill and judgment in discussing lessons recited by the children.

With respect to the lecture method, it may be said that the teacher of children should not be a mere lecturer in the usual sense of that term; and yet it may frequently happen that the instructor should be prepared to give the children a clear, strong, and full presentation of a topic, and every teacher should cultivate this power of simple, masterly narration and description. This kind of ability denotes complete control of the subject in hand and resourcefulness in presenting it to children.

Again, as to children learning lessons from books, they should from time to time be held to a high standard of proficiency in mastering and reproducing the substance of important subjects studied from books. Such proficiency requires serious, prolonged, and profitable effort on the part of children. It should not be formal and slavish, but free and thoughtful, and should be interspersed with questions and discussions which bring out rational freedom and independence in thought.

Four phases of instruction

There are four phases of classroom instruction which we wish to keep clearly in mind in the further discussion of the large units of study. They may be briefly summarized as follows:

First, the *Art of Questioning*. Questions are used in a variety of ways and it must be admitted that the question is the most frequent and important instrument used in teaching. (See preceding chapter.)

Secondly, *Problem-solving*, in which children are given a chance to use their own original powers in discovering, thinking out, and interpreting difficult situations.

Thirdly, *The Development Method* of teaching, by which children, by means of question and discussion, are thrown much upon their own resources in the acquisition of knowledge.

Fourthly, *Reviews and Drills*, by means of which teachers aim to secure greater thoroughness and retentiveness of knowledge.

It is not our purpose to enter upon a full and separate discussion of each of these already familiar points, but rather to observe how they relate themselves to the thought movements and processes which belong to large units of study.

As seen in an earlier chapter, the big unit of study offers a dynamic thought-movement. It contains within it a growing, expanding idea which organizes the facts and carries them through a developing process. At the basis of this process is the inductive-deductive movement which determines the main line of progress from the particular to the general in learning. This complete, progressive cycle of thought in a big topic is a broad and safe foundation for lesson planning and for method in classroom work. Every large unit of study is a complete thought enterprise or project as shown in treating the Panama Canal or in the reconstruction of Vienna. It has one central, purposive idea which works out its full meaning and value to the world in a unit of effort.

The dynamic thought-movement is a broad basis for method

We can well afford to put before children these strong study-units, with their copious thought materials, just to see how their spirits will respond to such bait. Too much we have been giving them a meager and tasteless diet and then have complained and criticized them because

they do not think or show a thirst for knowledge. This appetite for knowledge is what the intensive and enriching study of profitable topics will bring and bring with certainty if the teacher shows a reasonable mastery and skill.

Nor is it the purpose to pour out this copious fund of knowledge as dictated material, imposed by the teacher upon the docile minds of children. When once initiated into this forward movement and awakened to its wealth of knowledge, we are ready to open up problems and to enter into free discussions as to the relations of the facts and forces we are studying. For we have the information, the background of facts, the conditioning circumstances, upon which, as a sound basis, a solution of problems can be worked out. When, for example, we study the conditions at the mouth of the Mississippi River under which Captain Eads attacked the problem of the jetties and hoped to open a deep passage for large ships through the mud-bars to the Gulf and thus make New Orleans a great port, we furnish children with material or see that they get it with which to do their own thinking. They seize that opportunity eagerly, and push on to important and correct conclusions.

Not pure memory and dictated thought, but sharp questions and serious problems are propounded

It is under such conditions also that we as teachers can learn to frame good questions bearing on these problems. For example, How can the jetties be built to narrow the current? What material can be obtained and used for the construction of the jetties? How can the current of the water be turned more swiftly into this narrow channel when once formed? When abundant knowledge is at hand and focused on a progressive enterprise, questions may be asked that will give children a chance

to do most of the thinking. In our present teaching of subjects we have not time to put before children the full information upon which they can base their thinking, and we are actually dictating both the facts and the conclusions. The whole matter is briefly summarized and the children are required to appropriate it by a sheer act of memory.

The *question* is one of the teacher's most important instruments in developing and testing knowledge, but there is enormous waste and confusion as the result of loose and unpremeditated questioning. Questions need to be framed in relation to a developing line of thought, in which a clearly seen goal is set up and knowledge materials are assembled and brought to bear upon that goal. The big, well-organized unit of study clearly satisfies the two main conditions for good questioning, (1) an abundance of pertinent knowledge, (2) a forward effort on the basis of this knowledge toward a clearly-seen goal, in short, a purposeful thought movement.

Big topics prevent waste in questioning

The teacher should keep his mind centered upon the main idea as it grows, and the chief questions will point toward this developing thought. This presupposes in the mind of the teacher a definite organization of knowledge. Only those questions are admitted which clearly point out the main steps in this forward-moving thought. On any other basis it is difficult to see how we can avoid great waste in questioning.

The main idea in a big unit works itself out through a *series of difficulties*. (See Chapter XII.) In the Lewis and Clark expedition across the western mountains, the explorers are compelled to meet a succession of hardships

which stand out as real and knotty problems against which they pitted their ingenuity and their physical endurance. All important human enterprises have this problem-setting character, and our big units of study are reproductions of these typical experiences. The method of teaching such large subjects is a method of solving problems. The teacher must introduce these tasking situations with sufficient elaboration of the facts to qualify the children for thinking out a solution in each case. This shows why it is necessary to go somewhat fully into details. Otherwise the children have not the data upon which to base their reasoning. These data may sometimes be found in the previous knowledge of the children and can be drawn out by questions. At other times the facts must be presented directly by the teacher or obtained from textbooks and references. In any case fullness of knowledge is the only basis for sound thinking in the effort to solve problems. Questioning, in the absence of such knowledge, is a waste of time and is a not uncommon form of futile, disappointing mental effort.

A big unit of study is a developing series of problems, deeply imbedded in life situations

The large units of study are conspicuous for the fullness and elaborate presentation of the descriptive facts and circumstances which environ these problems. Big projects grow and develop out of such abundant accumulations of interesting knowledge materials. The thought develops and expands to large proportions because it has the thought-building stuff upon which to grow. Our present studies and classroom methods suffer sadly and inevitably because of the serious dearth of this vivifying circumstantiality of knowledge, this strong supporting background of facts. Even a good teacher is often completely handicapped by

this serious deficiency. The ordinary principles of teaching and the devices of method are helpless in the presence of this desert condition, this shortage of detailed knowledge. Our textbooks, except readings in good literature, have accustomed us to this lean and meager diet, but if real problems are to have any significance in our methods of instruction, a far richer accumulation of vitalizing knowledge must be collected along the developing course of every big unit of study. The mind, like a steam engine, requires a large amount of fuel. At present we are entirely too stingy with our deeper and richer knowledge resources. They are within our reach, if we will take the pains to collect and organize them. But our textbooks, under a seeming compulsion to spread out over a vast field, have stripped away most of this rich environment of thought and the teachers and children are left to travel along the barren ridges of a desert country.

In the first place, the course of study needs to be modified so as to make it possible to deal adequately with these big topics, and, secondly, well-trained experts who have plenty of time and abundant resources of knowledge should be asked to work out a satisfactory, elaborate treatment of these big units of study which can then be delivered into the hands of teachers and even of children. In other words, if teachers are to lead children into problem-solving modes of study, it is not well at the start and as a preliminary to lay upon the teacher an impossible burden of collecting and organizing material, but rather to see that he is well supplied with the equipment which is necessary for his success.

Presupposing such big, problem-solving projects in proper elaboration, the question of method at this point is how

to handle these problems. As to the teacher, the first duty is to find the central difficulty in each problem, and to know the definite facts that bear upon it — the whole background. This implies a superior quality of scholarship which is full and clear and practical. For example, in building the Roosevelt Dam for irrigation in the Salt River Valley, it was first necessary to decide upon the location of the dam with reference to forming a lake reservoir between the upper mountain sources of water on the one side, and the level lands in the lower valley on the other. Taking these and other important facts into consideration, where should the dam be located? With this pivotal question in mind and with a full knowledge of the conditioning facts, the teacher is ready to formulate other questions which will set the children to thinking. What are two or three most important matters to be considered in locating the dam? Where could it be most easily built? Where would they get the materials and supplies needed? To answer these questions it is advisable to have a full supply of pertinent and available information, and the teacher must first have it herself and then see to it that the children get possession of these facts, by studying maps or by reading and references or by the direct presentation on the teacher's part. A simple fact furnished by the teacher may sometimes give the children much to think about. For example, about forty miles up the river, above the lands to be irrigated, is a narrow, deep gorge in the course of the river. What of it?

Problems in their complete setting

It is worth noting that at every step, even in minor details of such a subject, the children meet problems, because a project like this is worked out by a constant

adjustment of means to ends in executing a larger whole, a complete undertaking.

Nor is it advisable to work out all these problems by question and answer, that is, by a development method. It would require too much time. Often a complete and interesting narrative or description is the better manner of getting facts and situations before the children. Here and there a question thrown in at a critical point will give the children their opportunity to help on the progress of thought, to solve problems. For example, — How is the water from the lake reservoir to be brought down the valley forty miles to the point where the flat lands lie which are to be irrigated? They should be encouraged to ask questions or to raise objections, while their ideas and opinions should be respected, even when they go astray. Even their mistakes give a favorable opportunity for impressing the truth by contrast. Absurd answers are sometimes given by children. Let the facts correct these absurdities.

Development questioning may easily be overdone

We may even go to the extreme of saying that the teacher should cultivate the power of vivid presentation of topics, of clear and simple exposition. He should develop in a variety of ways graphic power and illustrative resource. In aptness and force of language, he should increase more and more, and in using chalk at the blackboard for diagrams and drawings and maps, he should acquire that ease and versatility which betoken habit. In this direction the teacher grows into a professional expert; he possesses distinctive abilities or qualifications peculiar to his office. He should become not only a master of devices but a discoverer and inventor of devices. This ideal is actually

The teacher should cultivate a positive skill in oral presentation

reached in large measure by those who put themselves to the task, and it is a highly honorable achievement. It should not encroach upon the self-activity and independent thinking power of children, but lead up to and encourage self-reliance on their part.

For it is a great achievement to develop power of thought and expression in children, to lead them into these reflective processes, to let them struggle with knowledge materials, and work out clearly important results which they express in adequate terms of language. The large units of study, with their progressive organization and enriching thought materials, furnish the teacher the instruments with which to work out this result. When the children are well launched into one of these campaigns of study, their mental activities are awakened, their minds begin to fill up with ideas and with projects, and they are able to talk about and discuss problems in an almost masterful way. At least, one is often surprised by their power of thought and fullness and accuracy of speech. This never happens with poor and feeble knowledge, nor with mere conventional, textbook phraseologies. There must be a strong background of well-appreciated, organizing knowledge before this result is achieved.

To cultivate self-active thought in children is a great achievement

The teacher must know how to keep himself in the background, to unload the burden of thought and expression from himself upon the children, to guide the process of thought skillfully by an occasional suggestion or criticism, but to remain to a large extent a silent spectator. The child should learn to do things on his own responsibility. He is to understand that he does not know a thing till he can give a full

Transfer the burden of effort to the children

account of it from his own point of view, and from his own feeling of mastery. Let the teacher keep his hands off and let the child struggle with his own problem. Surely this is true in the final windup of any important discussion, in testing results after the full treatment of any larger subject. Our argument at this stage brings us to the point where thoroughness in the mastery of knowledge is of such importance that it calls for a system of careful tests.

Constructive Thoroughness

The general plan of working out and organizing the large unit of study provides at several points for a constructive thoroughness, that is, a thoroughness that is built up, steadily, by the natural growth and interconnection of thought as the subject unfolds. There is a prevalent opinion among teachers that thoroughness rests mainly upon repetitions and rigid drills. But thoroughness of the better type is that which rests first upon complete understanding of the thing to be learned. To see a thing clearly in its beginnings, growth, and essential relations, to comprehend it in its bearings on life and reality, to get an experimental, usable knowledge of a thing is to know it thoroughly. The thoroughness of knowledge that makes it efficient in use is what we want. There is a fictitious, rather pretentious, kind of thoroughness, based upon verbal drills and oft-repeated reviews, which has a strong resemblance to knowledge. But the best kind of knowledge is that which takes deep root and like a young plant soon acquires powers of independent assimilation and growth. In the large unit of study this growing energy, as a strong factor, is provided for in two ways.

Thoroughness is based on growth and organization in knowledge

First, in order to give the central idea in a large study-unit a chance to germinate, that is, to exhibit its life principle, a strong, active demonstration of this idea, as a positive, active force in the world, is effectively presented. Much pains is taken to uncover the strength of this idea and to let it manifest itself concretely in its full setting and influence. This explains why such elaborate efforts are made to gather descriptive data and to enrich and intensify the interesting, graphic details which environ the central thought. This point has been fully discussed and illustrated in previous chapters.

Conditions under which an idea germinates

The second step which provides for a solid and permanent structure of knowledge is the growth and expansion of the idea through a study and comparison of other real situations in which the same idea is operative. We must make sure of the scope of an idea, its power and influence in the world beyond this single example.

The growing and organizing stage

The growing stage in the large unit introduces a full series of these additional embodiments of the idea for serious examination and for comparison with the original. Ideas have to find a deep, rich soil in which to expand. They refuse to thrive in a thin, poor, or desert environment. It requires much time to collect sufficient variety of illustrative experience upon which to grow a strong and masterful idea. A purposive idea does not begin to show its larger influence till we have introduced a variety of important situations in which it reveals its dominant force. Textbooks are meager and almost valueless in this great effort to demonstrate the expansive power of ideas in a broader field. They either forget or underestimate the

value of this procedure or they leave it wholly to the teacher, who neglects it or has not time to provide for it. But when ideas fail to grow and expand, education in this direction comes to a standstill. We may try to make up for this by strenuous reviews and drills, but the foundation of sound knowledge is lacking and mere reviews and repetitions cannot compensate for the lack of vital knowledge. A considerable number of complete illustrations of this second important stage in the growth of ideas has been set forth in the preceding chapters.

In summing up we may note that the elaborate treatment of a big study-unit through its two main stages is a pledge that ideas first of all have taken deep root in good, rich soil; and, secondly, that they have continued to grow and mature under favorable culture till they have reached a full fruitage. This we are disposed to affirm as the necessary basis for all thoroughness in knowledge.

Summary

Apperceptive Use of Knowledge (See Chapter V)

In connection with these two main stages in the sound growth of knowledge there are two other phases of the process of thought which require special emphasis. In approaching any new subject or large unit, children should be summoned by a constant appeal to their previous experience. The course of study is laid out with the explicit intention of making earlier topics contribute important data for the interpretation of later subjects of study. In short, our course of study should be dominated by important ideas which keep reappearing as fundamental types, and these have great capacity for interpreting new but similar situations. Children, then, should be held to a constant use

Discovering old ideas in new situations

of their old ideas, or to a perpetual process of discovering old ideas in new situations. The habit of rediscovering ideas is one to be steadily cultivated both by teachers and children. It is an emphasis of the apperceptive use of knowledge. To state this principle in this form is simply to show where a serious difficulty lies. For it is one of the chief difficulties in class instruction to put this principle into frequent and steady use. New things, or those which seem to be new and strange, are usually hard to master. Children in school are ever coming up against just such new situations, and the skill of the teacher is tried to the limit at this crucial point. A new difficulty can usually be solved in one of two ways. If it is a lesson that involves a really new idea, it is necessary to introduce a full, concrete illustration, for example, a boomerang, or a catamaran. If, however, the new lesson contains an old principle in a new and strange form or dress, it can usually be explained by recalling the kindred idea or example and by discovering a similarity.

The far-reaching, interpretative value of strong types

The importance of the large type study is that it not only embodies an important idea in a typical object, and thus becomes the basis for the full development of a broad unit of study, but that it may be the first of an important series of type studies, based on the same idea, and extending more or less continuously through the whole length of the curriculum. In fact it expands and reaches into later life and becomes a center around which to group and interpret similar experiences in later life. The first full demonstration of an important type becomes thus a basis later for a rapid and effective interpretation of many so-called new and difficult lessons. When we add this consideration, that the basal types or ideas are few in number, that a few

fundamental ideas extending through the curriculum make the main framework upon which the whole course is built, we begin to realize the far-reaching, interpretative power of these few leading ideas, and also the simplicity of the course of study as a whole. The processes of instruction should be bent to the thorough working out of these main ideas in a continuous stream. But teachers often overlook this.

As instruction advances from grade to grade the central ideas become well developed and progress should be more rapid because the new situations can be interpreted quickly on the basis of previous studies. (See Chapter V.) This line of thought suggests the value of a very intensive study of a small number of fundamental projects in each school subject and a systematic use and application of these as interpreters and as a means of rapid progress through effective organization of studies. Our present short and scrappy treatment of important units of study fails to bring the main ideas into such a clear light, such a full demonstration, that they will in the future possess keen, interpretative power. Ideas do not become strong factors in the interpretation of new knowledge until they have acquired a certain dominant energy, until they have become rooted in one's progressive habits of thought, so that later incoming experience and knowledge are drawn in and absorbed by these stronger habits and preconceptions. It pays, therefore, to abide long enough with some central unit of thought so that its controlling idea may become a live center for future organizations. It becomes especially keen and strong in its power to interpret all similar situations where the same fundamental idea prevails — *e.g.* a thorough understanding of our Federal Gov-

The intensive study of a small group of basal ideas

ernment in its structure and functions will throw a quick and strong light upon all free governments and even upon other arbitrary governments by contrast.

The second important means of securing thoroughness is that of *review by comparison.* In several important studies, as in history, literature, science, and geography, systematic comparison of earlier with later studies is productive of reflective thinking, of rapid assimilation of knowledge, and of close organization upon central themes. (See Chapters V and XII.)

Review by comparison

One common reason for not making comparisons is that comparison requires special fullness and definiteness of knowledge. Our information on important subjects has been too meager to form a basis for thoughtful comparisons by which we may discover striking similarities and contrasts. The Missouri River, for example, is more than twice as long as the Ohio, but carries only half as much water into the Mississippi River as the Ohio. The causes and results of this wide difference are deserving of thoughtful study. The Rhine is more than three times as long as the Hudson and yet commercially the Hudson is fully as important as the Rhine. Why? This kind of information is not furnished by the books and such problems cannot be discussed till fuller information is at hand.

Our large units of study are elaborated with such descriptive fullness and their fundamental values are so clearly measured and defined that they become definite standards of value. We later return to them again and again as measuring units. The later and continuous comparisons of these with similar and with dissimilar objects of thought bring them into new lights and to greater clearness.

The big units become our standard measures of knowledge

By these perpetual comparisons, on the basis of a few standards of thought, our chief concepts are thoroughly worked over, organized, and mastered.

This regular and reflective use of comparisons in the second stage of big units of study would not only collect and organize our resources upon developing centers of thought, but it would almost put an end to our memoriter and static reviews, which at present form so large a part of the dulling routine of school study.

Reviews by comparison are highly stimulating to independent thought and they build up that steady organization of knowledge and that continuity of thought from year to year which is not only the best proof of thoroughness, but is a sure indication of the power to use knowledge and apply it to new situations. The type studies, by continually resurrecting the older fundamental ideas in study, furnish opportunity in every important topic for systematic review by comparison. In this way growth in knowledge becomes an assimilating, organizing process. The important ideas come to frequent review and what is learned is built into the organic mental structure so as to hold its place securely. Memory is based, not mainly upon repetition and drill, but upon vital association and upon strong and permanent growth in thought.

The main distinction between the conventional idea of review and drill and the view here presented is the difference between the static and the dynamic conception of learning. In our view the learning process is a perpetual forward-moving, assimilating growth. The older and prevailing view is that knowledge is a static accumulation, that can be tested and measured by examinations. While there is a static

The static and the dynamic view

element in knowledge, it needs to be kept flexible, or better still, growing and always reorganizing its elements. The Mississippi River, for example, is not so much an object as a process in nature, an exhibition of nature's forces operating on a gigantic scale. In order to understand the Mississippi River we must allow our minds to swing into the great current of action displayed by the river itself. Men have studied this river in its work and have learned to modify and direct its energy to a considerable extent. Captain Eads, by building the jetties, caused the current of the river to clear out and deepen its own channel so that large vessels could pass the delta bar. A careful study of this river in its physiographic and climatic conditions, in its developing life history, and in its regular and periodic mode of action is a sound basis for a complete understanding of the forces at work in a great river system. It is highly remunerative to spend many hours in camping along this great stream, in examining the work of its widely different tributaries, in marking its floods and man's efforts to curb them, in observing its navigable uses and water powers. We shall learn many important lessons that will give us a quick interpretation of other rivers so long as we continue our study of geography. Especially is this true if we will take time for thoughtful comparisons. In the elaborate study of the Mississippi we have a sound basis for organization of knowledge concerning all rivers, in a developing course. We fail to get this surprising benefit because we neglect to devote our time to an intensive, realistic study of a few big, dominant types. Having forfeited this first great advantage, of course we cannot use such types as centers of organization for the later studies. We are simply thrown back upon a memoriter drill.

INDEX

Printed in the United States of America.