

The Big Handbook of
**Nature
Study**
by Anna Botsford Comstock

PART ONE



**INTRODUCTION &
TEACHER'S GUIDE**

THE BIG HANDBOOK OF NATURE STUDY

by Anna Botsford Comstock

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HANDBOOK OF NATURE-STUDY

For Teachers and Parents

Based on the Cornell Nature-Study Leaflets, with Much
Additional Material and Many New Illustrations

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PREFACE

The Cornell University Nature-Study propaganda was essentially an agricultural movement in its inception and its aims; it was inaugurated as a direct aid to better methods of agriculture in New York State. During the years of agricultural depression 1891-1893, the Charities of New York City found it necessary to help many people who had come from the rural districts—a condition hitherto unknown. The philanthropists managing the Association for Improving the Condition of the Poor asked, "What is the matter with the land of New York State that it cannot support its own population?" A conference was called to consider the situation to which many people from different parts of the State were invited; among them was the author of this book, who little realized that in attending that meeting the whole trend of her activities would be thereby changed. Mr. George T. Powell, who had been a most efficient Director of Farmers' Institutes of New York State was invited to the conference as an expert to explain conditions and give advice as to remedies. The situation seemed so serious that a Committee for the Promotion of Agriculture in New York State was appointed. Of this committee the Honorable Abram S. Hewitt was Chairman, Mr. R. Fulton Cutting, Treasurer, Mr. Wm. H. Tolman, Secretary. The other members were Walter L. Suydam, Wm. E. Dodge, Jacob H. Schiff, George T. Powell, G. Howard Davidson, Howard Townsend, Professor I. P. Roberts, C. McNamee, Mrs. J. R. Lowell, and Mrs. A. B. Comstock. Mr. George T. Powell was made Director of the Department of Agricultural Education.

At the first meeting of this committee Mr. Powell made a strong plea for interesting the children of the country in farming as a remedial measure, and maintained that the first step toward agriculture was nature-study. It had been Mr. Powell's custom to give simple agricultural and nature-study instruction to the school children of every town where he was conducting a farmers' institute, and his opinion was, therefore, based upon experience. The committee desired to see for itself the value of this idea, and experimental work was suggested, using the schools of Westchester County as a laboratory. Mr. R. Fulton Cutting generously furnished the funds for this experiment, and work was done that year in the Westchester schools, which satisfied the committee of the soundness of the project.

The committee naturally concluded that such a fundamental movement must be a public rather than a private enterprise; and Mr. Frederick Nixon then Chairman of the Ways and Means Committee of the Assembly, was invited to meet with the committee at Mr. Hewitt's home. Mr. Nixon had been from the beginning of his public career deeply interested in improving the farming conditions of the State. In 1894, it was through

his influence and the support given him by the Chautauqua Horticultural Society under the leadership of Mr. John W. Spencer, that an appropriation had been given to Cornell University for promoting the horticultural interests of the western counties of the State. In addition to other work done through this appropriation, horticultural schools were conducted under the direction of Professor L. H. Bailey with the aid of other Cornell instructors and especially of Mr. E. G. Lodeman; these schools had proved to be most useful and were well attended. Therefore, Mr. Nixon was open-minded toward an educational movement. He listened to the plan of the committee and after due consideration declared that if this new measure would surely help the farmers of the State, the money would be forthcoming. The committee unanimously decided that if an appropriation were made for this purpose it should be given to the Cornell College of Agriculture; and that year eight thousand dollars was added to the Cornell University Fund, for Extension Teaching and inaugurating this work. The work was begun under Professor I. P. Roberts; after one year Professor Roberts placed it under the supervision of Professor L. H. Bailey, who for the fifteen years since has been the inspiring leader of the movement, as well as the official head.

In 1896, Mr. John W. Spencer, a fruit grower in Chautauqua County, became identified with the enterprise; he had lived in rural communities and he knew their needs. He it was who first saw clearly that the first step in the great work was to help the teacher through simply written leaflets; and later he originated the great plan of organizing the children in the schools of the State into Junior Naturalists Clubs, which developed a remarkable phase of the movement. The members of these clubs paid their dues by writing letters about their nature observations to Mr. Spencer, who speedily became their beloved "Uncle John;" a button and charter were given for continued and earnest work. Some years, 30,000 children were thus brought into direct communication with Cornell University through Mr. Spencer. A monthly leaflet for Junior Naturalists followed; and it was to help in this enterprise that Miss Alice G. McCloskey, the able Editor of the present *Rural School Leaflet*, was brought into the work. Later, Mr. Spencer organized the children's garden movement by forming the children of the State into junior gardeners; at one time he had 25,000 school pupils working in gardens and reporting to him.

In 1899, Mrs. Mary Rogers Miller, who had proven a most efficient teacher when representing Cornell nature-study in the State Teachers' Institutes, planned and started the Home Nature-Study Course Leaflets for the purpose of helping the teachers by correspondence, a work which fell to the author in 1903 when Mrs. Miller was called to other fields.

For the many years during which New York State has intrusted this important work to Cornell University, the teaching of nature-study has

gone steadily on in the University, in teachers' institutes, in State summer schools, through various publications and in correspondence courses. Many have assisted in this work, notably Dr. W. C. Thro, Dr. A. A. Allen, and Miss Ada Georgia. The New York Education Department with Charles R. Skinner as Commissioner of Education and Dr. Isaac Stout as the Director of Teachers' Institutes co-operated heartily with the movement from the first. Later with the co-operation of Dr. Andrew Draper, as Commissioner of Education, many of the Cornell leaflets have been written with the special purpose of aiding in carrying out the New York State Syllabus in Nature-Study and Agriculture.

The leaflets upon which this volume is based were published in the Home Nature-Study Course during the years 1903-1911, in limited editions and were soon out of print. It is to make these lessons available to the general public that this volume has been compiled. While the subject matter of the lessons herein given is essentially the same as in the leaflets, the lessons have all been rewritten for the sake of consistency, and many new lessons have been added to bridge gaps and make a coherent whole.

Because the lessons were written during a period of so many years, each lesson has been prepared as if it were the only one, and without reference to others. If there is any uniformity of plan in the lessons, it is due to the inherent qualities of the subjects, and not to a type plan in the mind of the writer; for, in her opinion, each subject should be treated individually in nature-study; and in her long experience as a nature-study teacher she has never been able to give a lesson twice alike on a certain topic or secure exactly the same results twice in succession. It should also be stated that it is not because the author undervalues physics nature-study that it has been left out of these lessons, but because her own work has been always along biological lines.

The reason why nature-study has not yet accomplished its mission, as thought-core for much of the required work in our public schools, is that the teachers are as a whole untrained in the subject. The children are eager for it, unless it is spoiled in the teaching; and whenever we find a teacher with an understanding of out-of-door life and a love for it, there we find nature-study in the school is an inspiration and a joy to pupils and teacher. It is because of the author's sympathy with the untrained teacher and her full comprehension of her difficulties and helplessness that this book has been written. These difficulties are chiefly three-fold: The teacher does not know what there is to see in studying a plant or animal; she knows little of the literature that might help her; and because she knows so little of the subject, she has no interest in giving a lesson about it. As a matter of fact, the literature concerning our common animals and plants is so scattered that a teacher would need a large library and almost unlimited time to prepare lessons for an extended nature-study course.

The writer's special work for fifteen years in Extension teaching has been the helping of the untrained teacher through personal instruction and through leaflets. Many methods were tried and finally there was evolved the method followed in this volume: All the facts available and pertinent concerning each topic have been assembled in the "Teacher's story" to make her acquainted with the subject; this is followed by an outline for observation on the part of the pupils while studying the object. It would seem that with the teacher's story before the eyes of the teacher, and the subject of the lesson before the eyes of the pupils with a number of questions leading them to see the essential characteristics of the object, there should result a wider knowledge of nature than is given in this or any other book.

That the lessons are given in a very informal manner, and that the style of writing is often colloquial, result from the fact that the leaflets upon which the book is based were written for a correspondence course in which the communications were naturally informal and chatty. That the book is meant for those untrained in science accounts for the rather loose terminology employed; as, for instance, the use of the word *seed* in the popular sense whether it be a drupe, an akene, or other form of fruit; or the use of the word *pod* for almost any seed envelope, and many like instances. Also, it is very likely, that in teaching quite incidentally the rudiments of the principles of evolution, the results may often seem to be confused with an idea of purpose, which is quite unscientific. But let the critic labor for fifteen years to interest the untrained adult mind in nature's ways, before he casts any stones! And it should be always borne in mind that if the author has not dipped deep in the wells of science, she has used only a child's cup.

For many years requests have been frequent from parents who have wished to give their children nature interests during vacations in the country. They have been borne in mind in planning this volume; the lessons are especially fitted for field work, even though schoolroom methods are so often suggested.

The author feels apologetic that the book is so large. However, it does not contain more than any intelligent country child of twelve should know of his environment; things that he should know naturally and without effort, although it might take him half his life-time to learn so much if he should not begin before the age of twenty. That there are inconsistencies, inaccuracies, and even blunders in the volume is quite inevitable. The only excuse to be offered is that, if through its use, the children of our land learn early to read nature's truths with their own eyes, it will matter little to them what is written in books.

The author wishes to make grateful acknowledgment to the following people: To Professor Wilford M. Wilson for his chapter on the weather; to Miss Mary E. Hill for the lessons on mould, bacteria, the minerals, and reading the weather maps; to Miss Catherine Straith for the lessons on

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TABLE OF CONTENTS

PART I

THE TEACHING OF NATURE-STUDY

	Page
What Nature-Study is.....	1
What Nature-Study Should do for the Child.....	1
Nature-Study as a Help to Health.....	2
What Nature-Study Should do for the Teacher.....	2
When and Why the Teacher Should say "I do not know!".....	3
Nature-Study, The Elixir of Youth.....	4
Nature-Study as a Help in School Discipline.....	4
The Relation of Nature-Study to Science.....	5
Nature-Study not for Drill.....	6
The Child not Interested in Nature-Study.....	6
When to Give the Lesson.....	6
The Length of the Lesson.....	7
The Nature-Study Lesson Always New.....	7
Nature-Study and Object Lessons.....	7
Nature-Study in the Schoolroom.....	8
Nature-Study and Museum Specimens.....	8
The Lens, Microscope and Field-glass as Helps.....	9
Use of Pictures, Charts and Blackboard Drawings.....	10
The Use of Scientific Names.....	10
The Story as a Supplement to the Nature-Study Lesson.....	10
The Nature-Study Attitude toward Life and Death.....	11
Should the Nature-Study Teacher Teach How to Destroy Life?.....	13
The Field Note-book.....	13
The Field Excursion.....	15
Pets as Nature-Study Subjects.....	15
The Correlation of Nature-Study with Language Work.....	16
The Correlation of Nature-Study with Drawing.....	17
The Correlation of Nature-Study with Geography.....	18
The Correlation of Nature-Study with History.....	18
The Correlation of Nature-Study with Arithmetic.....	19
Gardening and Nature-Study.....	20
Nature-Study and Agriculture.....	21
Nature-Study Clubs.....	22
How to Use this Book.....	24

PART II

ANIMAL LIFE

I Bird Study

Beginning Bird Study in the Primary Grades.....	25
Feathers as Clothing.....	27
Feathers as Ornament.....	30
How Birds Fly.....	33
Eyes and Ears of Birds.....	36

	Page
The Form and Use of Beaks.....	37
The Feet of Birds.....	39
Chicken Ways.....	41
Pigeons.....	45
The Canary and the Goldfinch.....	49
The Robin.....	54
The Bluebird.....	60
The White-breasted Nuthatch.....	63
The Chickadee.....	66
The Downy Woodpecker.....	69
The Sapsucker.....	73
The Redheaded Woodpecker.....	75
The Flicker or Yellow-hammer.....	77
The Meadowlark.....	80
The English Sparrow.....	84
The Chipping Sparrow.....	88
The Song Sparrow.....	91
The Mockingbird.....	94
The Catbird.....	98
The Belted Kingfisher.....	101
The Screech Owl.....	104
The Red Shouldered and Red Tailed Hawks.....	108
The Swallows and the Chimney Swift.....	112
The Hummingbird.....	120
The Red-winged Blackbird.....	122
The Baltimore Oriole.....	125
The Crow.....	129
The Cardinal Grosbeak.....	133
Geese.....	136
The Turkey.....	143
The Study of Birds' Nests in Winter.....	147

II Fish Study

The Goldfish.....	149
The Bullhead.....	154
The Common Sucker.....	158
The Shiner.....	161
Brook Trout.....	164
The Stickleback.....	168
The Sunfish.....	172
The Johnny Darter.....	177

III Batrachian Study

The Common Toad.....	181
The Tadpole Aquarium.....	185
The Tree-frog or Tree-toad.....	190
The Frog.....	193
The Newt, Eft or Salamander.....	197

IV Reptile Study

The Garter or Garden Snake.....	201
The Milk Snake, or Spotted Adder.....	204

Table of Contents

XIII

	Page
The Water Snake	206
The Turtle.....	208

V Mammal Study

The Cotton-tail Rabbit.....	213
The Muskrat.....	218
The House Mouse.....	224
The Woodchuck.....	229
The Red Squirrel or Chickaree.....	233
Furry.....	238
The Chipmunk.....	240
The Little Brown Bat.....	243
The Skunk.....	247
The Raccoon.....	250
The Wolf.....	255
The Fox.....	257
Dogs.....	261
The Cat.....	268
The Goat.....	275
The Sheep.....	281
The Horse.....	286
Cattle.....	295
The Pig.....	303

VI Insect Study

The Life History of Insects.....	308
The Structure of Insects.....	312
The Black Swallow-tail Butterfly.....	315
The Monarch Butterfly.....	320
The Isabella Tiger Moth or Woolly Bear.....	326
The Cecropia.....	330
The Promethea.....	336
The Hummingbird, or Sphinx, Moths.....	340
The Codling Moth.....	347
Leaf-miners.....	352
The Leaf-rollers.....	357
The Gall-dwellers.....	360
The Grasshopper.....	365
The Katydid.....	370
The Black Cricket.....	373
The Snowy Tree-cricket.....	377
The Cockroach.....	378
How to Make an Aquarium for Insects.....	380
The Dragon-flies and Damsel-flies.....	382
The Caddis-worms and the Caddis-flies.....	387
The Aphids or Plant Lice.....	392
The Ant-lion.....	395
Mother Lace-wing and the Aphis-lion.....	397
The Mosquito.....	400
The House-fly.....	405
The Colorado Potato-beetle.....	409

	Page
The Ladybird	413
The Firefly	416
The Ways of the Ant	419
How to Make a Lubbock Ant-Nest	423
The Ant-Nest and What May be Seen Within it	425
The Mud-dauber	429
The Yellow-jacket	432
The Leaf-cutter Bee	436
The Little Carpenter Bee	439
The Bumblebee	442
The Honey-bee	445
The Honey-comb	451
Industries of the Hive and the Observation Hive	453

VII Other Invertebrate-Animal Study

The Garden Snail	458
The Earthworm	462
The Crayfish	466
Daddy Longlegs, or Grandfather Greybeard	472
Spiders	475
The Funnel-web	477
The Orb-web	478
The Filmy Dome	483
Ballooning Spiders	484
The White Crab-Spider	485
How the Spider Mothers Take Care of their Young	487

PART III

PLANT LIFE

How to Begin the Study of Plants and Flowers	489
How to Make Plants Comfortable	490
How to Teach the Names of the Parts of a Flower	492
Teach the Use of a Flower	493
Flowers and Insect Partners	494
The Relation of Plants to Geography	495
Seed Germination	495

I Wild-flower Study

The Hepatica	496
The Yellow Adder's Tongue	499
Bloodroot	503
The Trillium	506
Dutchman's Breeches and Squirrel Corn	509
Jack-in-the-Pulpit	512
The Violet	515
The May Apple or Mandrake	519
The Bluets	523
The Yellow Lady's Slipper, or Moccasin Flower	525
The Common Buttercup	528
The Evening Primrose	530

Table of Contents

XV

	Page
The Hedge Bindweed	535
The Dodder	538
The Milkweed	540
The White Water Lily	545
Pondweed	548
The Cat-tail	551
A Type Lesson for a Composite Flower	554
The Goldenrod	555
The Asters	558
The White Daisy	560
The Yellow Daisy or Black-eyed Susan	562
The Thistle	563
The Burdock	566
Prickly Lettuce, A Compass Plant	570
The Dandelion	572
The Pearly Everlasting	576
The Jewelweed, or Touch-me-not	578
Mullein	582
The Teasel	586
Queen Anne's Lace, or Wild Carrot	589
Weeds	594
Outline for the Study of a Weed	595

II Cultivated-Plant Study

The Crocus	596
Daffodils and their Relatives	599
The Tulip	603
The Pansy	607
The Bleeding Heart	611
Poppies	613
The California Poppy	616
The Nasturtium	620
The Bee-Larkspur	623
The Blue Flag, or Iris	626
The Sunflower	631
The Bachelor's Button	636
The Salvia or Scarlet Sage	637
Petunias	640
The Horseshoe Geranium	643
The Sweet Pea	649
The Clovers	652
Sweet Clover	655
The White Clover	658
Maize, or Indian Corn	660
The Cotton Plant	666
The Strawberry	672
The Pumpkin	675

III Flowerless-Plant Study

The Christmas Fern	684
The Bracken	689
How a Fern Bud Unfolds	691

	Page
The Fruiting of the Fern	693
The Field Horsetail	699
The Hair-cap Moss, or Pigeon Wheat	702
Mushrooms and other Fungi	706
Puffballs	712
The Bracket Fungi	714
Hedgehog Fungi	717
The Scarlet Saucer	718
The Morels	719
The Stinkhorns	720
Molds	720
Bacteria	723

IV Tree Study

How a Tree Grows	726
How to Begin Tree Study	731
How to Make Leaf Prints	734
The Maples	736
The American Elm	745
The Oak	748
The Shagbark Hickory	755
The Chestnut	757
The Horse-Chestnut	761
The Willows	765
The Cottonwood or Carolina Poplar	770
The White Ash	774
The Apple Tree	778
How an Apple Grows	782
The Apple	785
The Pine	789
The Norway Spruce	796
The Hemlock	801
The Flowering Dogwood	803
The Staghorn Sumac	806
The Witch-Hazel	810
The Mountain Laurel	813

PART IV

EARTH AND SKY

The Brook	818
How a Brook Drops its Load	822
Crystal Growth	825
Salt	827
How to Study Minerals	828
Quartz	829
Feldspar	831
Mica	832
Granite	833
Calcite, marble and Limestone	835
The Magnet	838
The Soil	842

	Page
Water Forms.....	850
The Weather.....	857
Experiments to Show Air Pressure.....	877
The Barometer.....	878
How to read Weather Maps.....	879
The Story of the Stars.....	887
How to Begin Star Study.....	889
Cassiopeia's Chair, Cepheus and the Dragon.....	893
The Winter Stars.....	895
Orion.....	895
Aldebaran and the Pleiades.....	897
The Two Dog-Stars, Sirius and Procyon.....	898
Capella and the Heavenly Twins.....	900
The Stars of Summer.....	901
The Sun.....	905
The Relation between the Tropic of Cancer and the Planting of the Garden.....	909
The Zodiac and its Signs.....	911
The Relations of the Sun to the Earth.....	913
How to Make a Sun-dial.....	915
The Moon.....	918

*In Nature's infinite book of secrecy
A little can I read.*

—SHAKESPEARE.

PART I.

THE TEACHING OF NATURE-STUDY

WHAT NATURE-STUDY IS



NATURE-STUDY is, despite all discussions and perversions, a study of nature; it consists of simple, truthful observations that may, like beads on a string, finally be threaded upon the understanding and thus held together as a logical and harmonious whole. Therefore, the object of the nature-study teacher should be to cultivate in the children powers of accurate observation and to build up within them, understanding.

WHAT NATURE-STUDY SHOULD DO FOR THE CHILD



FIRST, but not most important, nature-study gives the child practical and helpful knowledge. It makes him familiar with nature's ways and forces, so that he is not so helpless in the presence of natural misfortune and disasters.

Nature-study cultivates the child's imagination since there are so many wonderful and true stories that he may read with his own eyes, which affect his imagination as much as does fairy lore; at the same time nature-study cultivates in him a perception and a regard for what *is* true, and the power to express it. All things seem possible in nature; yet this seeming is always guarded by the eager quest of what is true. Perhaps, half the falsehood in the world is due to lack of power to detect the truth and to express it. Nature-study aids both in discernment and expression of things as they are.

Nature-study cultivates in the child a love of the beautiful; it brings to him early a perception of color, form and music. He sees whatever there is in his environment, whether it be the thunder-head piled up in the western sky, or the golden flash of the oriole in the elm; whether it be the purple of the shadows on the snow, or the azure glint on the wing of the little butterfly. Also, what there is of sound, he hears; he reads the music score of the bird orchestra, separating each part and knowing which bird sings it. And the patter of the rain, the gurgle of the brook, the sighing of the wind in the pine, he notes and loves and becomes enriched thereby.

But, more than all, nature-study gives the child a sense of companionship with life out of doors and an abiding love of nature. Let this latter be the teacher's criterion for judging his or her work. If nature-study as taught does not make the child love nature and the out-of-doors, then it should cease. Let us not inflict permanent injury on the child by turning him away from nature instead of toward it. However, if the love of nature is in the teacher's heart, there is no danger; such a teacher, no

matter by what method, takes the child gently by the hand and walks with him in paths that lead to the seeing and comprehending of what he may find beneath his feet or above his head. And these paths whether they lead among the lowliest plants, or whether to the stars, finally converge and bring the wanderer to that serene peace and hopeful faith that is the sure inheritance of all those who realize fully that they are working units of this wonderful universe.

NATURE-STUDY AS A HELP TO HEALTH



PERHAPS the most valuable practical lesson the child gets from nature-study is a personal knowledge that nature's laws are not to be evaded. Wherever he looks, he discovers that attempts at such evasion result in suffering and death. A knowledge thus naturally attained of the immutability of nature's "must" and "shall not" is in itself a moral education. That the fool as well as the transgressor fares ill in breaking natural laws, makes for wisdom in morals as well as in hygiene.

Out-of-door life takes the child afield and keeps him in the open air, which not only helps him physically and occupies his mind with sane subjects, but keeps him out of mischief. It is not only during childhood that this is true, for love of nature counts much for sanity in later life. This is an age of nerve tension, and the relaxation which comes from the comforting companionship found in woods and fields is, without doubt, the best remedy for this condition. Too many men who seek the out-of-doors for rest at the present time, can only find it with a gun in hand. To rest and heal their nerves they must go out and try to kill some unfortunate creature,—the old, old story of sacrificial blood. Far better will it be when, through properly training the child, the man shall be enabled to enjoy nature through seeing how creatures live rather than watching them die. It is the sacred privilege of nature-study to do this for future generations and for him thus trained, shall the words of Longfellow's poem to Agassiz apply:

*"And he wandered away and away, with Nature the dear old nurse,
Who sang to him night and day, the rhymes of the universe.
And when the way seemed long, and his heart began to fail,
She sang a more wonderful song, or told a more wonderful tale."*

WHAT NATURE-STUDY SHOULD DO FOR THE TEACHER



URING many years, I have been watching teachers in our public schools in their conscientious and ceaseless work; and so far as I can foretell, the fate that awaits them finally is either nerve exhaustion or nerve atrophy. The teacher must become either a neurasthenic or a "clam."

I have had conversations with hundreds of teachers in the public schools of New York State concerning the introduction of nature-study into the curriculum, and most of them declared, "Oh, we have not time for it. Every moment is full now!" Their nerves were at such a tension that with one more thing to do they must fall apart. The question in my own mind during these conversations was always, how long can she

stand it! I asked some of them "Did you ever try a vigorous walk in the open air in the open country every Saturday or every Sunday of your teaching year?" "Oh no!" they exclaimed in despair of making me understand. "On Sunday we must go to church or see our friends and on Saturday we must do our shopping or our sewing. We must go to the dressmaker's lest we go unclad, we must mend, and darn stockings; we need Saturday to catch up."

Yes, catch up with more cares, more worries, more fatigue, but not with more growth, more strength, more vigor and more courage for work. In my belief, there are two and only two occupations for Saturday afternoon or forenoon for a teacher. One is to be out of doors and the other is to lie in bed, and the first is best. Out in this, God's beautiful world, there is everything waiting to heal lacerated nerves, to strengthen tired muscles, to please and content the soul that is torn to shreds with duty and care. To the teacher who turns to nature's healing, nature-study in the schoolroom is not a trouble; it is a sweet, fresh breath of air blown across the heat of radiators and the noisome odor of over-crowded small humanity. She, who opens her eyes and her heart nature-ward even once a week, finds nature-study in the schoolroom a delight and an abiding joy. What does such a one find in her schoolroom instead of the terrors of discipline, the eternal watching and eternal nagging to keep the pupils quiet and at work? She finds, first of all, companionship with her children; and second, she finds that without planning or going on a far voyage, she has found health and strength.

WHEN AND WHY THE TEACHER SHOULD SAY "I DO NOT KNOW"

NO SCIENCE professor in any university, if he be a man of high attainment, hesitates to say to his pupils "I do not know," if they ask for information beyond his knowledge. The greater his scientific reputation and erudition, the more readily, simply and without apology he says this. He, better than others, comprehends how vast is the region that lies beyond man's present knowledge. It is only the teacher in the elementary schools who has never received enough scientific training to reveal to her how little she does know, who feels that she must appear to know everything or her pupils will lose confidence in her. But how useless is this pretence, in nature-study! The pupils, whose younger eyes are much keener for details than hers, will soon discover her limitations and then their distrust of her will be real.

In nature-study any teacher can with honor say, "I do not know;" for perhaps, the question asked is as yet unanswered by the great scientists. But she should not let her lack of knowledge be a wet blanket thrown over her pupils' interest. She should say frankly, "I do not know; let us see if we cannot together find out this mysterious thing. Maybe no one knows it as yet, and I wonder if you will discover it before I do." She thus conveys the right impression, that only a little about the intricate life of plants and animals is yet known; and at the same time she makes her pupils feel the thrill and zest of investigation. Nor will she lose their respect by doing this, if she does it in the right spirit. For three years, I had for comrades in my walks afield, two little children and they kept me

busy saying, "I do not know". But they never lost confidence in me or in my knowledge; they simply gained respect for the vastness of the unknown.

The chief charm of nature-study would be taken away if it did not lead us through the border-land of knowledge into the realm of the undiscovered. Moreover, the teacher, in confessing her ignorance and at the same time her interest in a subject, establishes between herself and her pupils a sense of companionship which relieves the strain of discipline, and gives her a new and intimate relation with her pupils which will surely prove a potent element in her success. The best teacher is always one who is the good comrade of her pupils.

NATURE-STUDY, THE ELIXIR OF YOUTH



THE old teacher is too likely to become didactic, dogmatic and "bossy" if she does not constantly strive with herself. Why? She has to be thus five days in the week and, therefore, she is likely to be so seven. She knows arithmetic, grammar and geography to their uttermost and she is never allowed to forget that she knows them, and finally her interests become limited to what she knows.

After all, what is the chief sign of growing old? Is it not the feeling that we know all there is to be known? It is not years which make people old; it is ruts, and a limitation of interests. When we no longer care about anything except our own interests, we are then old, it matters not whether our years be twenty or eighty. It is rejuvenation for the teacher, thus growing old, to stand ignorant as a child in the presence of one of the simplest of nature's miracles—the formation of a crystal, the evolution of the butterfly from the caterpillar, the exquisite adjustment of the silken lines in the spider's orb-web. I know how to "make magic" for the teacher who is growing old. Let her go out with her youngest pupil and fall on her knees before the miracle of the blossoming violet and say: "Dear Nature, I know naught of the wondrous life of these, your smallest creatures. Teach me!" and she will suddenly find herself young.

NATURE-STUDY AS A HELP IN SCHOOL DISCIPLINE



MUCH of the naughtiness in school is a result of the child's lack of interest in his work, augmented by the physical inaction that results from an attempt to sit quietly. The best teachers try to obviate both of these rather than to punish because of them. Nature-study is an aid in both respects, since it keeps the child interested and also gives him something to do.

In the nearest approach to an ideal school that I have ever seen, for children of second grade, the pupils were allowed, as a reward of merit, to visit the aquaria or the terrarium for periods of five minutes, which time was given to the blissful observation of the fascinating prisoners. The teacher also allowed the reading of stories about the plants and animals under observation to be regarded as a reward of merit. As I entered the schoolroom, there were eight or ten of the children at the windows watching eagerly what was happening to the creatures confined there in the various cages. There was a mud aquarium for the frogs and salamanders,

an aquarium for fish, many small aquaria for insects and each had one or two absorbingly interested spectators who were quiet, well behaved and were getting their nature-study lessons in an ideal manner. The teacher told me that the problem of discipline was solved by this method, and that she was rarely obliged to rebuke or punish. In many other schools, watching the living creatures in the aquaria, or terrarium has been used as a reward for other work well done.

THE RELATION OF NATURE-STUDY TO SCIENCE



NATURE-STUDY is not elementary science as so taught, because its point of attack is not the same; error in this respect has caused many a teacher to abandon nature-study and many a pupil to hate it. In elementary science the work begins with the simplest animals and plants and progresses logically through to the highest forms; at least this is the method pursued in most universities and schools. The object of the study is to give the pupils an outlook over all the forms of life and their relation one to another. In nature-study the work begins with any plant or creature which chances to interest the pupil. It begins with the robin when it comes back to us in March, promising spring; or it begins with the maple leaf which flutters to the ground in all the beauty of its autumnal tints. A course in biological science leads to the comprehension of all kinds of life upon our globe. Nature-study is for the comprehension of the individual life of the bird, insect or plant that is nearest at hand.

Nature-study is perfectly good science within its limits, but it is not meant to be more profound or comprehensive than the capabilities of the child's mind. More than all, nature-study is not science belittled as if it were to be looked at through the reversed opera glass in order to bring it down small enough for the child to play with. Nature-study, as far as it goes, is just as large as is science for "grown-ups" and may deal with the same subject matter and should be characterized by the same accuracy. It simply does not go so far.

To illustrate: If we are teaching the science of ornithology, we take first the *Archaeopteryx*, then the swimming and the scratching birds and finally reach the song birds, studying each as a part of the whole. Nature-study begins with the robin because the child sees it and is interested in it and he notes the things about the habits and appearance of the robin that may be perceived by intimate observation. In fact, he discovers for himself all that the most advanced book of ornithology would give concerning the ordinary habits of this one bird; the next bird studied may be the turkey in the barnyard, or the duck on the pond, or the screech-owl in the spruces, if any of these happen to impinge upon his notice and interest. However, such nature-study makes for the best of scientific ornithology, because by studying the individual birds thus thoroughly, the pupil finally studies a sufficient number of forms so that his knowledge, thus assembled, gives him a better comprehension of birds as a whole than could be obtained by the routine study of the same. Nature-study does not start out with the classification given in books, but in the end it builds up a classification in the child's mind which is based on fundamental knowledge; it is a classification like that evolved by the first naturalists, it is built on careful personal observations of both form and life.

NATURE-STUDY NOT FOR DRILL

If nature-study is made a drill, its pedagogic value is lost. When it is properly taught, the child is unconscious of mental effort or that he is suffering the act of teaching. As soon as nature-study becomes a task, it should be dropped; but how could it ever be a task to see that the sky is blue, or the dandelion golden, or to listen to the oriole in the elm!

THE CHILD NOT INTERESTED IN NATURE-STUDY



WHAT to do with the pupil not interested in nature-study subjects is a problem that confronts many earnest teachers. Usually the reason for this lack of interest, is the limited range of subjects used for nature-study lessons. Often the teacher insists upon flowers as the lesson subject, when toads or snakes would prove the key to the door of the child's interest. But whatever the cause may be, there is only one right way out of this difficulty: The child not interested should be kept at his regular school work and not admitted as a member of the nature-study class, where his influence is always demoralizing. He had much better be learning his spelling lesson than learning to hate nature through being obliged to

study subjects in which he is not interested. In general, it is safe to assume that the pupil's lack of interest in nature-study is owing to a fault in the teacher's method. She may be trying to fill the child's mind with facts when she should be leading him to observe these for himself, which is a most entertaining occupation for the child. It should always be borne in mind that mere curiosity is always impertinent, and that it is never more so than when exercised in the realm of nature. A genuine interest should be the basis of the study of the lives of plants and lower animals. Curiosity may elicit facts, but only real interest may mold these facts into wisdom.

WHEN TO GIVE THE LESSON



HERE are two theories concerning the time when a nature-study lesson should be given. Some teachers believe that it should be a part of the regular routine; others have found it of greatest value if reserved for that period of the school day when the pupils are weary and restless, and the teacher's nerves strained to the snapping point. The lesson on a tree, insect or flower at such a moment affords immediate relief to everyone; it is a mental excursion, from which all return refreshed and ready to finish the duties of the day.

While I am convinced that the use of the nature-study lesson for mental refreshment makes it of greatest value, yet I realize fully that if it is relegated to such periods, it may not be given at all. It might be better to give it a regular period late in the day, for there is strength and sureness in regularity. The teacher is much more likely to prepare herself for the lesson, if she knows that it is required at a certain time.

THE LENGTH OF THE LESSON



THE nature-study lesson should be short and sharp and may vary from ten minutes to a half hour in length. There should be no dawdling; if it is an observation lesson, only a few points should be noted and the meaning for the observations made clear. If an outline be suggested for field observation, it should be given in an inspiring manner which shall make each pupil anxious to see and read the truth for himself. The nature story when properly read is never finished; it is always at an interesting point, "continued in our next."

The teacher may judge as to her own progress in nature-study by the length of time she is glad to spend in reading from nature's book what is therein written. As she progresses, she finds those hours spent in studying nature speed faster, until a day thus spent seems but an hour. The author can think of nothing she would so gladly do as to spend days and months with the birds, bees and flowers with no obligation for telling what she should see. There is more than mere information in hours thus spent. Lowell describes them well when he says:

*"Those old days when the balancing of a yellow butterfly o'er a thistle bloom
Was spiritual food and lodging for the whole afternoon."*

THE NATURE-STUDY LESSON ALWAYS NEW

A nature-study lesson should not be repeated unless the pupils demand it. It should be done so well the first time that there is no need of repetition, because it has thus become a part of the child's consciousness. The repetition of the same lesson in different grades was, to begin with, a hopeless incubus upon nature-study. One disgusted boy declared, "Darn germination! I had it in the primary and last year and now I am having it again. I know *all about germination*." The boy's attitude was a just one; but if there had been revealed to him the meaning of germination, instead of the mere process, he would have realized that until he had planted and observed every plant in the world he would not know all about germination, because each seedling has its own interesting story. The only excuse for repeating a nature-study lesson is in recalling it for comparison and contrast with other lessons. The study of the violet will naturally bring about a review of the pansy; the dandelion, of the sunflower; the horse, of the donkey; the butterfly, of the moth.

NATURE-STUDY AND OBJECT LESSONS



THE object lesson method was introduced to drill the child to see a thing accurately, not only as a whole, but in detail and to describe accurately what he saw. A book or a vase or some other object was held up before the class for a moment and then removed; afterwards the pupils described it as perfectly as possible. This is an excellent exercise and the children usually enjoy it as if it were a game. But if the teacher has in mind the same thought when she is giving the nature-study lesson, she has little comprehension of the meaning of the latter and the pupils will have less. In nature-study, it is not desirable that the child see all the details, but rather those details that have something to do with the life of the creature studied; if he sees that the

grasshopper has the hind legs much longer than the others, he will inevitably note that there are two other pairs of legs and he will in the meantime have come into an illuminating comprehension of the reason the insect is called "grasshopper." The child should see definitely and accurately all that is necessary for the recognition of a plant or animal; but in nature-study, the observation of form is for the purpose of better understanding life. In fact, it is form linked with life, the relation of "being" to "doing."

NATURE-STUDY IN THE SCHOOLROOM



ANY subjects for nature-study lessons may be brought into the schoolroom. Whenever it is possible, the pupils should themselves bring the material, as the collecting of it is an important part of the lesson. There should be in the schoolroom conveniences for caring for the little prisoners brought in from the field. The terrarium and breeding cages, of different kinds should be provided for the insects, toads and little mammals. Here they may live in comfort, when given their natural food, while the children observe their interesting ways. The ants' nest, and the observation hive yield fascinating views of the marvelous lives of the insect socialists, while the cheerful prisoner in the bird cage may be made a constant illustration of the adaptations and habits of all birds. The aquaria for fishes, tadpoles and insects afford the opportunity for continuous study of these water creatures and are a never-failing source of interest to the pupils, while the window garden may be made not only an ornament and an æsthetic delight, but a basis for interesting study of plant growth and development.

A schoolroom thus equipped is a place of delight as well as enlightenment to the children. Once, a boy whose luxurious home was filled with all that money could buy and educated tastes select, said of a little nature-study laboratory which was in the unfinished attic of a school building, but which was teeming with life: "I think this is the most beautiful room in the world."

NATURE-STUDY AND MUSEUM SPECIMENS



THE matter of museum specimens is another question for the nature-study teacher to solve, and has a direct bearing on an attitude toward taking life. There are many who believe the stuffed bird or the case of pinned insects have no place in nature-study; and certainly these should not be the chief material. But let us use our common sense; the boy sees a bird in the woods or field and does not know its name; he seeks the bird in the museum and thus is able to place it and read about it and is stimulated to make other observations concerning it. Wherever the museum is a help to the study of life in the field, it is well and good. Some teachers may give a live lesson from a stuffed specimen, and other teachers may stuff their pupils with facts about a live specimen; of the two, the former is preferable.

There is no question that making a collection of insects is an efficient way of developing the child's powers of close observation, as well as of giving him manual dexterity in handling fragile things. Also it is a false sentiment which attributes to an insect the same agony at being

impaled on a pin that we might suffer at being thrust through by a stake. The insect nervous system is far more conveniently arranged for such an ordeal than ours; and, too, the cyanide bottle brings immediate and painless death to the insects placed within it; moreover, the insects usually collected have short lives anyway. So far as the child is concerned, he is thinking of his collection of moths or butterflies and not at all of taking life; so it is not teaching him to wantonly destroy living creatures. However, an indiscriminate encouragement of the making of insect collections cannot be advised. There are some children who will profit by it and some who will not, and unquestionably the best kind of study of insects is watching their interesting ways while they live.

To kill a creature in order to prepare it for a nature-study lesson is not only wrong but absurd, for nature-study has to do with life rather than death, and the form of any creature is interesting only when its adaptations for life are studied. But again, a nature-study teacher may be an opportunist; if without any volition on her part or the pupils', a freshly killed specimen comes to hand, she should make the most of it. The writer remembers most illuminating lessons from a partridge that broke a window and its neck simultaneously during its flight one winter night, a yellow hammer that killed itself against an electric wire, and a muskrat that turned its toes to the skies for no understandable reason. In each of these cases the creature's special physical adaptations for living its own peculiar life were studied, and the effect was not the study of a dead thing, but of a successful and wonderful life.

THE LENS, MICROSCOPE AND FIELD GLASS AS HELPS IN NATURE-STUDY



N elementary grades, nature-study deals with objects which the children can see with the naked eye. However, a lens is a help in almost all of this work because it is such a joy to the child to gaze at the wonders it reveals. There is no lesson given in this book which requires more than a simple lens for seeing the most minute parts discussed. An excellent lens may be bought for a dollar, and a fairly good one for fifty cents or even twenty-five cents. The lens should be chained to a table or desk where it may be used by the pupils at recess. This gives each an opportunity for using it and obviates the danger of losing it. If the pupils themselves own lenses, they should be fastened by a string or chain to the pocket.

A microscope has no legitimate part in nature-study. But if there is one available, it reveals so many wonders in the commonest objects, that it can be made a source of added interest oftentimes. For instance, to thus see the scales on the butterfly's wing affords the child pleasure as well as edification. Field or opera glasses, while indispensable for bird study, are by no means necessary in nature-study. However, the pupils will show greater interest in noting the birds' colors if they are allowed to make the observations with the help of a glass.

USES OF PICTURES, CHARTS AND BLACKBOARD DRAWINGS



PICTURES alone should never be used as the subjects for nature-study lessons, but they may be of great use in illustrating and illuminating a lesson. Books well illustrated are more readily comprehended by the child and are often very helpful to him, especially after his interest in the subject is thoroughly aroused. If charts are used to illustrate the lesson, the child is likely to be misled by the size of the drawing, which is also the case in blackboard pictures. However, this error may be avoided by fixing the attention of the pupil on the object first. If the pupils are studying the ladybird and have it in their hands, the teacher may use a diagram representing the beetle as a foot long and it will still convey the idea accurately; but if she begins with the picture, she probably can never convince the children that the picture has anything to do with the insect.

In making blackboard drawings illustrative of the lesson, it is best, if possible, to have one of the pupils do the drawing in the presence of the class; or, if the teacher does the drawing, she should hold the object in her hand while doing it and look at it often so that the children may see that she is trying to represent it accurately. Taking everything into consideration, however, nature-study charts and blackboard drawings are of little use to the nature-study teacher.

THE USES OF SCIENTIFIC NAMES



DISQUIETING problems relative to scientific nomenclature always confront the teacher of nature-study. My own practice has been to use the popular names of species, except in cases where confusion might ensue, and to use the scientific names for anatomical parts. However, this matter is of little importance if the teacher bears in mind that the purpose of nature-study is to know the subject under observation and to learn the name incidentally.

If the teacher says: "I have a pink hepatica. Can anyone find me a blue one?" the children, who naturally like grown-up words, will soon be calling these flowers hepaticas. But if the teacher says, "These flowers are called hepaticas. Now please everyone remember the name. Write it in your books as I write it on the blackboard, and in half an hour I shall ask you again what it is," the pupils naturally look upon the exercise as a word lesson and its real significance is lost. This sort of nature-study is dust and ashes and there has been too much of it. The child should never be *required* to learn the name of anything in the nature-study work; but the name should be used so often and so naturally in his presence, that he will learn it without being conscious of the process.

THE STORY AS A SUPPLEMENT TO THE NATURE-STUDY LESSON



MANY of the subjects for nature lessons can be studied only in part, since but one phase may be available at the time. Often, especially if there is little probability that the pupils will find opportunity to complete the study, it is best to round out their knowledge by reading or telling the story to supplement the facts which they have discov-

ered for themselves. This story should not be told as a finality or as a complete picture but as a guide and inspiration for further study. Always leave at the end of the story an interrogation mark that will remain aggressive and insistent in the child's mind. To illustrate: Once a club of junior naturalists brought me rose leaves injured by the leaf-cutter bee and asked me why the leaves were cut out so regularly. I told them the story of the use made by the mother bee of these oval and circular bits of leaves and made the account as vital as I was able; but at the end I said, "I do not know which species of bee cut these leaves. She is living here among us and building her nest with your rose leaves which she is cutting every day almost under your very eyes. Is she then so much more clever than you that you cannot see her nor find her nest?" For two years following this lesson I received letters from members of this club. Two carpenter bees and their nests were discovered by them and studied before the mysterious leaf-cutter was finally ferreted out. My story had left something interesting for the young naturalists to discover. The children should be impressed with the fact that the nature story is never finished. There is not a weed nor an insect nor a tree so common that the child, by observing carefully, may not see things never yet recorded in scientific books; therefore the supplementary story should be made an inspiration for keener interest and further investigation on the part of the pupil. The supplementary story simply thrusts aside some of the obscuring underbrush thus revealing more plainly the path to further knowledge.

THE NATURE-STUDY ATTITUDE TOWARD LIFE AND DEATH

PERHAPS no greater danger besets the pathway of the nature-study teacher than the question involved in her pupils' attitude toward life and death. To inculcate in the child a reverence for life and yet to keep him from becoming mawkish and morbid is truly a problem. It is almost inevitable that the child should become sympathetic with the life of the animal or plant studied, since a true understanding of the life of any creature creates an interest which stimulates a desire to protect this particular creature and make its life less hard. Many times, within my own experience, have I known boys, who began by robbing birds' nests for egg collections, to end by becoming most zealous protectors of the birds. The humane qualities within these boys budded and blossomed in the growing knowledge of the lives of the birds. At Cornell University, it is a well known fact that those students who turn aside so as not to crush the ant, caterpillar or cricket on the pavement are almost invariably those that are studying entomology; and in America it is the botanists themselves who are leading the crusade for flower protection.

Thus, the nature-study teacher, if she does her work well, is a sure aid in inculcating a respect for the rights of all living beings to their own lives; and she needs only to lend her influence gently in this direction to change carelessness to thoughtfulness and cruelty to kindness. But with this impetus toward a reverence for life, the teacher soon finds herself in a dilemma from which there is no logical way out, so long as she lives in a world where lamb chop, beefsteak and roast chicken are articles of ordi-

nary diet; a world in fact, where every meal is based upon the death of some creature. For if she places much emphasis upon the sacredness of life, the children soon begin to question whether it be right to slay the lamb or the chicken for their own food. It would seem that there is nothing for the consistent nature-study teacher to do but become a vegetarian, and even then there might arise refinements in this question of taking life, she might have to consider the cruelty to asparagus in cutting it off in plump infancy, or the ethics of devouring in the turnip the food laid up by the mother plant to perfect her seed. In fact, a most rigorous diet would be forced upon the teacher who should refuse to sustain her own existence at the cost of life; and if she should attempt to teach the righteousness of such a diet she would undoubtedly forfeit her position; and yet what is she to do! She will soon find herself in the position of a certain lady who placed sheets of sticky fly-paper around her kitchen to rid her house of flies, and then in mental anguish picked off the buzzing, struggling victims and sought to clean their too adhesive wings and legs.

In fact, drawing the line between what to kill and what to let live, requires the use of common sense rather than logic. First of all, the nature-study teacher, while exemplifying and encouraging the humane attitude toward the lower creatures, and repressing cruelty which wantonly causes suffering, should never magnify the terrors of death. Death is as natural as life and the inevitable end of physical life on our globe. Therefore, every story and every sentiment expressed which makes the child feel that death is terrible, is wholly wrong. The one right way to teach about death is not to emphasize it one way or another, but to deal with it as a circumstance common to all; it should be no more emphasized than the fact that creatures eat or fall asleep.

Another thing for the nature-study teacher to do is to direct the interest of the child so that it shall center upon the hungry creature rather than upon the one which is made into the meal. It is well to emphasize the fact that one of the conditions imposed upon every living being in the woods and fields, is that it is entitled to a meal when it is hungry, if it is clever enough to get it. The child naturally takes this view of it. I remember well as a child I never thought particularly about the mouse which my cat was eating; in fact, the process of transmuting mouse into cat seemed altogether proper, but when the cat played with the mouse, that was quite another thing, and was never permitted. Although no one appreciates more deeply than I the debt which we owe to Thompson-Seton and writers of his kind, who have placed before the public the animal story from the animal point of view and thus set us all to thinking, yet it is certainly wrong to impress this view too strongly upon the young and sensitive child. In fact, this process should not begin until the judgment and the understanding is well developed, for we all know that although seeing the other fellow's standpoint is a source of strength and breadth of mind, yet living the other fellow's life is, at best, an enfeebling process and a futile waste of energy.

SHOULD THE NATURE-STUDY TEACHER TEACH HOW TO DESTROY LIFE ?



IT IS probably within the proper scope of the nature-study teacher to place emphasis upon the domain of man, who being the most powerful of all animals, asserts his will as to which ones shall live in his midst. From a standpoint of abstract justice, the stray cat has just as much right to kill and eat the robin which builds in the vine of my porch as the robin has to pull and eat the earthworms from my lawn; but the place is mine, and I choose to kill the cat and preserve the robin.

When emphasizing the domain of man, we may have to deal with the killing of creatures which are injurious to his interests. Nature-study may be tributary to this, in a measure, and indirectly, but it is surely *not* nature-study. For example, the child studies the cabbage butterfly in all its stages, the exquisitely sculptured yellow egg, the velvety green caterpillar, the chrysalis with its protecting colors, the white-winged butterfly, and becomes interested in the life of the insect. Not under any consideration, when the attention of the child is focused on the insect, should we suggest a remedy for it when a pest. Let the life-story of the butterfly stand as a fascinating page of nature's book. But later, when the child enters on his career as a gardener, when he sets out his row of cabbage plants and waters and cultivates them, and does his best to bring them to maturity, along comes the butterfly, now an arch enemy, and begins to rear her progeny on the product of his toil. Now the child's interest is focused on the cabbage, and the question is not one of killing insects so much as of saving plants. In fact, there is nothing in spraying the plants with Paris green which suggests cruelty to innocent caterpillars, nor is the process likely to harden the child's sensibilities.

To gain knowledge of the life-story of insects or other creatures is nature-study. To destroy them as pests is a part of Agriculture or Horticulture. The one may be of fundamental assistance to the other, but the two are quite separate and should never be confused.

THE FIELD NOTE-BOOK

A field note-book may be made a joy to the pupil and a help to the teacher. Any kind of a blank book will do for this, except that it should not be too large to be carried in the pocket, and it should always have the pencil attached. To make the note-book a success the following rules should be observed:

(a) The book should be considered the personal property of the child and should never be criticized by the teacher except as a matter of encouragement; for the spirit in which the notes are made, is more important than the information they cover.

(b) The making of drawings should be encouraged for illustrating what is observed. A graphic drawing is far better than a long description of a natural object.

(c) The note-book should not be regarded as a part of the work in English. The spelling, language and writing of the notes should all be exempt from criticism.

(d) As occasion offers, outlines for observing certain plants or animals may be placed in the note-book previous to the field excursion so as to give definite points for the work.

I have examined many field note-books kept by pupils in the intermediate grades and have been surprised at their plenitude of accurate observation and graphic illustration. These books ranged from blank account books furnished by the family grocer up to a quarto, the pages of which were adorned with many marginal illustrations made in passionate admiration of Thompson-Seton's books and filled with carefully transcribed text, that showed the direct influence of Thoreau. These books, of whatever quality, are precious beyond price to their owners. And why not? For they represent what cannot be bought or sold, personal experience in the happy world of out-of-doors.

THE FIELD EXCURSION



MANY teachers look upon the field excursion as a precarious voyage, steered between the Scylla of hilarious seeing too much and the Charybdis of seeing nothing at all because of the zest which comes from freedom in the fields and wood. This danger can be obviated if the teacher plans the work definitely before starting, and demands certain results.

It is a mistake to think that a half day is necessary for a field lesson, since a very efficient field trip may be made during the ten or fifteen minutes at recess, if it is well planned. Certain questions and lines of investigation should be given the pupils before starting and given in such a manner as to make them thoroughly interested in discovering the facts. A certain teacher in New York State has studied all the common plants and trees in the vicinity of her school with these recess excursions and the pupils have been enthusiastic about the work.

The half hour excursion should be preceded by a talk concerning the purposes of the outing and the pupils must know that certain observations are to be made or they will not be permitted to go again. This should not be emphasized as a punishment; but they should be made to understand that a field excursion is only, naturally enough, for those who wish to see and understand outdoor life. For all field work, the teacher should make use of the field notebook which should be a part of the pupils' equipment.

PETS AS NATURE-STUDY SUBJECTS



LITTLE attention has been given to making the child understand what would be the lives of his pets if they were in their native environment; or to relating their habits and lives as wild animals. Almost any pet, if properly observed, affords an admirable opportunity for understanding the reasons why its structure and peculiar habits may have made it successful among other creatures and in other lands.

Moreover the actions and the daily life of the pet make interesting subject matter for a note-book. The lessons on the dog, rabbit and horse as given in this volume may suggest methods for such study, and with apologies that it is not better and more interesting, I have placed with the story of the squirrel a few pages from one of my own note-books regarding my experiences with "Furry." I include this record as a suggestion for the children that they should keep note-books of their pets. It will lead

them to closer observation and to a better and more natural expression of their experiences.

THE CORRELATION OF NATURE-STUDY WITH LANGUAGE WORK



NATURE-STUDY should be so much a part of the child's thought and interest that it will naturally form a thought core for other subjects quite unconsciously on his part. In fact, there is one safe rule for correlation in this case, it is legitimate and excellent training as long as the pupil does not discover that he is correlating. But there is something in human nature which revolts against doing one thing to accomplish quite another. A boy once said to me, "I'd rather never go on a field excursion than to have to write it up for English," a sentiment I sympathized with keenly; ulterior motive is sickening to the honest spirit. But if that same boy had been a member of a field class and had enjoyed all the new experiences and had witnessed the interesting things discovered on this excursion, and if later his teacher had asked him to write for her an account of some part of it, because *she wished to know what he had discovered*, the chances are that he would have written his story joyfully and with a certain pride that would have counted much for achievement in word expression.

When Mr. John Spencer, known to so many children in New York State as "Uncle John," was conducting the Junior Naturalist Clubs, the teachers allowed letters to him to count for language exercises; and the eagerness with which these letters were written should have given the teachers the key to the proper method of teaching English. Mr. Spencer requested the teachers not to correct the letters, because he wished the children to be thinking about the subject matter rather than the form of expression. But so anxious were many of the pupils to make their letters perfect, that they earnestly requested their teachers to help them write correctly, which was an ideal condition for teaching them English. Writing letters to Uncle John was such a joy to the pupils that it was used as a privilege and a reward of merit in many schools. One rural teacher reduced the percentage of tardiness to a minimum by giving the first period in the morning to the work in English which consisted of letters to Uncle John.

Why do pupils dislike writing English exercises? Simply because they are not interested in the subject they are asked to write about, and they know that the teacher is not interested in the information contained in the essay. But when they are interested in the subject and write about it to a person who is interested, the conditions are entirely changed. If the teacher, overwhelmed as she is by work and perplexities, could only keep in mind that the purpose of a language is, after all, merely to convey ideas, some of her perplexities would fade away. A conveyance naturally should be fitted for the load it is to carry, and if the pupil acquires the load first he is very likely to construct a conveyance that will be adequate. How often the conveyance is made perfect through much effort and polished through agony of spirit and the load entirely forgotten!

Nature-study lessons give much excellent subject matter for stories and essays, but these essays should never be criticized or defaced with the blue pencil. They should be read with interest by the teacher; the mis-

takes made in them, so transformed as to be unrecognizable, may be used for drill exercises in grammatical construction. After all, grammar and spelling are only gained by practice and there is no royal road leading to their acquirement.

THE CORRELATION OF NATURE-STUDY AND DRAWING



THE correlation of nature-study and drawing is so natural and inevitable that it needs never be revealed to the pupil. When the child is interested in studying any object, he enjoys illustrating his observations with drawings; the happy absorption of children thus engaged is a delight to witness. At its best, drawing is a perfectly natural method of self-expression. The savage and the young child, both untutored, seek to express themselves and their experiences by this means. It is only when the object to be drawn is foreign to the interest of the child that drawing is a task.

Nature-study offers the best means for bridging the gap that lies between the kindergarten child who makes drawings because he loves to and is impelled to from within, and the pupil in the grades who is obliged to draw what the teacher places before him. From making crude and often meaningless pencil strokes, which is the entertainment of the young child, the outlining of a leaf or some other simple and interesting natural object, is a normal step full of interest for the child because it is still self-expression.

Miss Mary E. Hill gives every year in the Goodyear School of Syracuse an exhibition of the drawings made by the children in the nature-study classes; and these are universally so excellent that most people regard them as an exhibition from the Art Department; and yet many of these pupils have never had lessons in drawing. They have learned to draw because they like to make pictures of the living objects which they have studied. One year there were many pictures of toads in various stages in this exhibit, and although their anatomy was sometimes awry in the pictures, yet there was a certain vivid expression of life in their representation; one felt that the toads could jump. Miss Hill allows the pupils to choose their own medium, pencil, crayon, or water-color, and says that they seem to feel which is best. For instance, when drawing the outline of trees in winter they choose pencil, but when representing the trillium or iris they prefer the water-color, while for bitter-sweet and crocuses they choose the colored crayons.

It is through this method of drawing that which interests him, that the child retains and keeps as his own, what should be an inalienable right, a graphic method of expressing his own impressions. Too much have we emphasized drawing as an art; it may be an art, if the one who draws is an artist; but if he is not an artist he still has a right to draw if it pleases him to do so. We might as well declare that a child should not speak unless he put his words into poetry, as to declare that he should not draw because his drawings are not artistic.

THE CORRELATION OF NATURE-STUDY WITH GEOGRAPHY



LIFE depends upon its environment. Geographical conditions and limitations have shaped the mold into which plastic life has been poured and by which its form has been modified. It may be easy for the untrained mind to see how the deserts and oceans affect life. Cattle may not roam in the former because there is nothing there for them to eat, nor may they occupy the latter because they are not fitted for breathing air in the water. And yet the camel can endure thirst and live on the scant food of the desert; and the whale is a mammal fitted to live in the sea. The question is, how are we to impress the child with the "have to" which lies behind all these geographical facts. If animals live in the desert they *have to* subsist on scant and peculiar food which grows there; they *have to* get along with little water; they *have to* endure heat and sand storms; they *have to* have eyes that will not become blinded by the vivid reflection of the sunlight on the sand; they *have to* be of sand color so that they may escape the eyes of their enemies or creep upon their prey unperceived.

All these have to's are not mere chance, but they have existed so long that the animal, by constantly coming in contact with them, has attained its present form and habits.

There are just as many have to's in the stream or the pond back of the school-house, on the dry hillside behind it or in the woods beyond the creek as there are in desert or ocean; and when the child gets an inkling of this fact, he has made a great step into the realm of geography. When he realizes why water lilies can grow only in still water that is not too deep and which has a silt bottom, and why the cat-tails grow in swamps where there is not too much water, and why the mullen grows in the dry pasture, and why the hepatica thrives in the rich, damp woods, and why the daisies grow in the meadows, he will understand that this partnership of nature and geography illustrates the laws which govern life. Many phases of physical geography belong to the realm of nature-study; the brook, its course, its work of erosion and sedimentation; the rocks of many kinds, the soil, the climate, the weather, are all legitimate subjects for nature-study lessons.

THE CORRELATION OF NATURE-STUDY WITH HISTORY



HERE are many points where nature-study impinges upon history in a way that may prove the basis for an inspiring lesson. Many of our weeds, cultivated plants and domestic animals have been introduced from Europe and are a part of our colonial history; while there are many of the most commonly seen creatures which have played their part in the history of ancient times. For instance, the bees which gave to man the only means available to him for sweetening his food until the 17th century, were closely allied to the home life of ancient peoples. The buffalo which ranged our western plains had much to do with the life of the red man. The study of the grasshopper brings to the child's attention stories

of the locusts' invasion mentioned in the Bible, and the stars which witnessed our creation and of which Job sang and the ancients wrote, shine over our heads every night.

But the trees, through the lengthy span of their lives, cover more history individually, than do other organisms. In glancing across the wood-covered hills of New York one often sees there, far above the other trees, the gaunt crowns of old white pines. Such trees belonged to the forest primeval and may have attained the age of two centuries; they stand there looking out over the world, relics of another age when America belonged to the red man, and the bear and the panther played or fought beneath them. The cedars live longer than do the pines and the great scarlet oak may have attained the age of four centuries before it yields to fate.

Perhaps in no other way may the attention of the pupil be turned so naturally to past events, as through the thought that the life of such a tree has spanned so much of human history. The life history of one of these ancient trees should be made the center of local history; let the pupils find when the town was first settled by the whites and where they came from and how large the tree was then. What Indian tribes roamed the woods before that and what animals were common in the forest when this tree was a sapling? Thus may be brought out the chief events in the history of the county and township, when they were established and for whom or what they were named; and a comparison of the present industries may be made with those of a hundred years ago.




THE CORRELATION OF NATURE-STUDY WITH ARITHMETIC

THE arithmetical problems presented by nature-study are many; some of them are simple and some of them are complicated, and all of them are illuminating. Seed distribution especially lends itself to computation; a milkweed pod contains 140 seeds; there are five such pods on one plant, each milkweed plant requires at least one square foot of ground to grow on; how much ground would be required to grow all of the seeds from this one plant? Or, count the seeds in one dandelion head, multiply by the number of flower heads on the plant and estimate how many plants can grow on a square foot, then ask a boy how long it would take for one dandelion plant to cover his father's farm with its progeny; or count the blossoms on one branch of an apple tree, later count the ripened fruit; what percentage of blossoms matured into fruit? Measuring trees, their height and thickness and computing the lumber they will make combines arithmetic and geometry, and so on *ad infinitum*.

As a matter of fact, the teacher will find in almost every nature lesson an arithmetic lesson; and when arithmetic is used in this work, it should be vital and inherent and not "tacked on;" the pupils should be really interested in the answers to their problems; and as with all correlation, the success of it depends upon the genius of the teacher.

GARDENING AND NATURE-STUDY


RRONEOUSLY, some people maintain that gardening is nature-study; this is not so necessarily nor ordinarily. Gardening may be a basis for nature-study but it is rarely made so to any great extent. Even the work in children's gardens is so conducted that the pupils know little or nothing of the flowers or vegetables which they grow except their names, their uses to man and how to cultivate them. They are taught how to prepare the soil, but the reason for this from the plant's standpoint is never revealed; and if the child becomes acquainted with the plants in his garden, he makes the discovery by himself. All this is nothing against gardening! It is a wholesome and valuable experience for a child to learn how to make a garden even if he remains ignorant of the interesting facts concerning the plants which he there cultivates. But if the teachers are so inclined, they may find in the garden and its products, the most interesting material for the best of nature lessons. Every plant the child grows is an individual with its own peculiarities as well as those of its species in manner of growth. Its roots, stems and leaves are of certain form and structure; and often the special uses to the plant of its own kind of leaves, stems and roots are obvious. Each plant has its own form of flower and even its own tricks for securing pollination; and its own manner of developing and scattering its seeds. Every weed of the garden has developed some special method of winning and holding its place among the cultivated plants; and in no other way may the child so fully and naturally come into a comprehension of that term "the survival of the fittest" as by studying the ways of the fit as exemplified in the triumphant weeds of his garden.

Every earthworm working below the soil is doing something for the garden. Every bee that visits the flowers there is on an errand for the garden as well as for herself. Every insect feeding on leaf or root is doing something to the garden. Every bird that nests near by or that ever visits it, is doing something which affects the life and the growth of the garden. What all of these uninvited guests are doing is one field of garden nature-study. Aside from all this study of individual life in the garden which even the youngest child may take part in, there are the more advanced lessons on the soil. What kind of soil is it? From what sort of rock was it formed? What renders it mellow and fit for the growing of plants? Moreover, what do the plants get from it? How do they get it? What do they do with what they get?

This leads to the subject of plant physiology, the elements of which may be taught simply by experiments carried on by the children themselves, experiments which should demonstrate the sap currents in the plant; the use of water to carry food and in making the plant rigid; the use of sunshine in making the plant food in the leaf laboratories; the nourishment provided for the seed and its germination, and many other similar lessons.

A child who makes a garden, and thus becomes intimate with the plants he cultivates, and comes to understand the interrelation of the various forms of life which he finds in his garden, has progressed far in the fundamental knowledge of nature's ways as well as in a practical knowledge of agriculture.

NATURE-STUDY AND AGRICULTURE



LUCKILY, thumb-rule agriculture is being pushed to the wall in these enlightened days. Thumb rules would work much better if nature did not vary her performances in such a confusing way. Government experiment stations were established because thumb rules for farming were unreliable and disappointing; and all the work of all the experiment stations has been simply advanced nature-study and its application to the practice of agriculture. Both nature-study and agriculture are based upon the study of life and the physical conditions which encourage or limit life; this is known to the world as the study of the natural sciences; and if we see clearly the relation of nature-study to science, we may understand better the relation of nature-study to agriculture, which is based upon the sciences.

Nature-study is science brought home. It is a knowledge of botany, zoology and geology as illustrated in the dooryard, the corn-field or the woods back of the house. Some people have an idea that to know these sciences one must go to college; they do not understand that nature has furnished the material and laboratories on every farm in the land. Thus, by beginning with the child in nature-study we take him to the laboratory of the wood or garden, the roadside or the field, and his materials are the wild flowers or the weeds, or the insects that visit the golden-rod or the bird that sings in the maple tree, or the woodchuck whistling in the pasture. The child begins to study living things anywhere or everywhere, and his progress is always along the various tracks laid down by the laws of life, along which his work as an agriculturist must always progress if it is to be successful.

The child through nature-study learns the way a plant grows, whether it be an oak, a turnip or a pigweed; he learns how the roots of each is adapted to its needs; how the leaves place themselves to get the sunshine and why they need it; and how the flowers get their pollen carried by the bee or wind; and how the seeds are finally scattered and planted. Or he learns about the life of the bird, whether it be a chicken, an owl or a bobolink; he knows how each bird gets its food and what its food is, where it lives, where it nests and its relation to other living things. He studies the bumblebee and discovers its great mission of pollen carrying for many flowers, and in the end would no sooner strike it dead than he would voluntarily destroy his clover patch. This is the kind of learning we call nature-study and not science or agriculture. But the country child can never learn anything in nature-study that has not something to do with science; and that has not its own practical lesson for him, when he shall become a farmer.

Some have argued, "Why not make nature-study along the lines of agriculture solely? Why should not the child begin nature-study with the cabbage rather than the wild flowers?" This argument carried out logically provides recreation for a boy in hoeing corn rather than in playing ball. Many parents in the past have argued thus and have, in consequence, driven thousands of splendid boys from the country to the city with a loathing in their souls for the drudgery which seemed all there was to farm life. The reason why the wild flowers may be selected for begin-

ning the nature-study of plants, is because every child loves these woodland posies, and his happiest hours are spent in gathering them. Never yet have we known of a case where a child having gained his knowledge of the way a plant lives through studying the plants he loves, has failed to be interested and delighted to find that the wonderful things he discovered about his wild flower may be true of the vegetable in the garden, or the purslane which fights with it for ground to stand upon.

Some have said, "We, as farmers, care only to know what concerns our pocket-books; we wish only to study those things which we must, as farmers, cultivate or destroy. We do not care for the butterfly, but we wish to know the plum weevil; we do not care for the trillium but we are interested in the onion; we do not care for the meadow-lark but we cherish the gosling." This is an absurd argument since it is a mental impossibility for any human being to discriminate between two things when he knows or sees only one. In order to understand the important economic relations to the world of one plant or animal, it is absolutely necessary to have a wide knowledge of other plants and animals. One might as well say, "I will see the approaching cyclone, but never look at the sky; I will look at the clover but not see the dandelion; I will look for the sheriff when he comes over the hill but will not see any other team on the road."

Nature-study is an effort to make the individual use his senses instead of losing them; to train him to keep his eyes open to all things so that his powers of discrimination shall be based on wisdom. The ideal farmer is not the man who by hazard and chance succeeds; he is the man who loves his farm and all that surrounds it because he is awake to the beauty as well as to the wonders which are there; he is the man who understands as far as may be the great forces of nature which are at work around him, and therefore, he is able to make them work for him. For what is agriculture save a diversion of natural forces for the benefit of man! The farmer who knows these forces only when restricted to his paltry crops, and has no idea of their larger application, is no more efficient as a farmer than would a man be as an engineer who knew nothing of his engine except how to start and stop it.

In order to appreciate truly his farm, the farmer must needs begin as a child with nature-study; in order to be successful and make the farm pay, he must needs continue in nature-study; and to make his declining years happy, content, full of wide sympathies and profitable thought, he must needs conclude with nature-study; for nature-study is the alphabet of agriculture and no word in that great vocation may be spelled without it.

NATURE-STUDY CLUBS



THE organizing of a club by the pupils for the purpose of studying out-of-door life, is a great help and inspiration to the work in nature-study in the classroom. The essays and the talks before the club, prove efficient aid in English composition; and the varied interests of the members of the club, furnish new and vital material for study. A button or a badge may be designed for the club and, of course, it must have constitution and by-laws. The proceedings of the club meetings should be conducted according to parliamentary rules; but the field excursions

should be entirely informal.

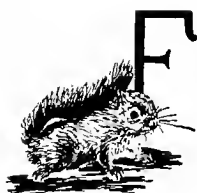
The meetings of the Junior Naturalists Clubs, as organized in the schools of New York State by Mr. John W. Spencer, were most impressive. The school session would be brought to a close, the teacher stepping down and taking a seat with the pupils. The president of the club, some bashful boy or slender slip of a girl would take the chair and conduct the meeting with a dignity and efficiency worthy of a statesman. The order was perfect, the discussion much to the point. I confess to a feeling of awe when I attended these meetings, conducted so seriously and so formally, by such youngsters. Undoubtedly, the parliamentary training and experience in speaking impromptu, are among the chief benefits of such a club.

These clubs may be organized for special study. In one bird club of which I know there have been contests. Sides were chosen and the number of birds seen from May 1st to 31st inclusive was the test of supremacy. Notes on the birds were taken in the field with such care, that when at the end of the month each member handed in his notes, they could be used as evidence of accurate identification. An umpire with the help of bird manuals decided the doubtful points. This year the score stood 79 to 81.

The programs of the nature club should be varied so as to be continually interesting. Poems and stories, concerning the objects studied, help make the program attractive.



HOW TO USE THIS BOOK



FIRST and indispensably, the teacher should have at hand the subject of the lesson. She should make herself familiar with the points covered by the questions and read the story before giving the lesson. If she does not have the time to go over the observations suggested, before giving the lesson, she should take up the questions with the pupils as a joint investigation, and be boon companion in discovering the story.

The story should not be read to the pupils. It is given as an assistance to the teacher, and is not meant for direct information to the pupils. If the teacher knows a fact in nature's realm, she is then in a position to lead her pupils to discover this fact for themselves.

Make the lesson an investigation and make the pupils feel that they are investigators. To tell the story to begin with, inevitably spoils this attitude and quenches interest.

The "leading thought" embodies some of the points which should be in the teacher's mind while giving the lesson; it should not be read or declared to the pupils.

The outlines for observations herein given, by no means cover all of the observations possible; they are meant to suggest to the teacher observations of her own, rather than to be followed slavishly.

The suggestions for observations have been given in the form of questions, merely for the sake of saving space. The direct questioning method, if not employed with discretion, becomes tiresome to both pupil and teacher. If the questions do not inspire the child to investigate, they are useless. To grind out answers to questions about any natural object is not nature-study, it is simply "grind," a form of mental activity which is of much greater use when applied to spelling or the multiplication table than to the study of nature. The best teacher will cover the points suggested for observations with few direct questions. To those who find the questions inadequate I will say that, although I have used these outlines once, I am sure I should never be able to use them again without making changes.

The topics chosen for these lessons may not be the most practical nor the most interesting nor the most enlightening that are to be found; they are simply those subjects which I have used in my classes, because we happened to find them at hand the mornings the lessons were given.

While an earnest attempt has been made to make the information in this book accurate, it is to be expected and to be hoped that many discrepancies will be found by those who follow the lessons. No two animals or plants are just alike, and no two people see things exactly the same way. The chief aim of this volume is to encourage investigation rather than to give information. Therefore, if mistakes are found, the object of the book will have been accomplished, and the author will feel deeply gratified. If the teacher finds that the observations made by her and her pupils, do not agree with the statements in the book, I earnestly enjoin upon her to trust to her own eyes rather than to any book.

No teacher is expected to teach all the lessons in this book. A wide range of subjects is given, so that congenial choice may be made.