

STANDARD PROGRAM OF STUDIES
FOR THE
SECONDARY SCHOOLS
OF NEW HAMPSHIRE

DEPARTMENT OF
PUBLIC INSTRUCTION

1906



Class LP 1612

Book N 443

OFFICIAL DONATION.

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OF NEW HAMPSHIRE

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Supplement to Biennial Report

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IRA C. EVANS CO., PRINTERS, CONCORD, N. H.

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PREFACE.

The curricula and courses here presented are intended to express the judgment of the Department of Public Instruction as to the standards which are sufficient to constitute a high school within the meaning of chapter 96, Session Laws of 1901. It is also expected that they will serve as suggestive to local authority and teachers, and that they will tend to effect a desirable unity both within the state and between the secondary institutions of New Hampshire and those of other states.

In establishing these curricula and the standards of the various courses, the superintendent has had the formal advice of the educational council of New Hampshire and a committee of that body has done a major part of the actual work. This committee was composed of Principal George H. Libby of Manchester, Superintendent Joseph H. Blaisdell of Laconia, Principal Willis O. Smith of Lancaster, and Principal Charles L. Wallace of Lisbon, in consultation with the state superintendent.

The committee and the department have had the assistance of Superintendent A. H. Keyes of Dover, Dr. T. W. Harris of Keene, Superintendent M. C. Smart of Littleton, Principal S. W. Robertson of Rochester, Principal J. W. Hobbs of Portsmouth, Professor E. D. Sanderson of New Hampshire College of Agriculture and the Mechanic Arts.

Although substantially all the work has been scrutinized and more or less amended by the committee above referred to, and by the Superintendent, and all has been edited by the latter, acknowledgement is made of services for the several parts of the work as follows:

English, Principal Hobbs; Latin and Greek, Superintendent Keyes; Modern Languages, Superintendent Smart;

History, Principal Robertson; Mathematics, Principal Wallace; Physics and Chemistry, Principal Smith; Biology, Dr. Harris. The curriculum in Mechanic Arts with its courses entire is the work of Principal Smith, as well as the extensive and detailed work in Physics and Chemistry. The curriculum in Agriculture was outlined by a committee of the faculty of the State College, under the chairmanship of Professor E. D. Sanderson. The commercial curriculum was developed with great care by Principal Libby.

In the whole work, the committee has been guided by the various similar documents published by the National Educational Association, and so far as possible has intended to make this work conform to the standards therein laid down by the chief professional body of America.

General acknowledgment is also made to the Educational Department of New York for constant guidance afforded by its Syllabus for Secondary Schools.

It is therefore declared that the standards herein established are recognized as authoritative for the State of New Hampshire, and they are commended to the attention and consideration of the authorities of all approved secondary schools.

HENRY C. MORRISON,

Superintendent of Public Instruction.

CONCORD, Sept. 4, 1906.

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INTRODUCTION.

Definitions.—In this work various technical terms are used in the meanings here given.

Program.—The program, or program of studies of a school, is its whole or general plan of work, often indefinitely known as course of study.

Curriculum.—A curriculum is a subdivision or phase of a program leading through some related series of courses and giving a characteristic discipline. For instance, Latin-Scientific, English, Classical courses, are more properly called curricula.

Course.—A course is the work of one year or one semester in a single subject. For instance, Curriculum I shows four courses in Latin, three in Greek, two in history, etc.

Semester.—A half-year of school work.

Secondary.—A secondary school is one teaching subjects or parts of subjects which are commonly recognized as falling between the scope of the elementary school and that of the college.

The Elementary school embraces that part of school life lying between the kindergarten and the secondary school, being usually of eight grades.

THE LAW OF 1901 upon which the legal character of the approved high school or academy rests is here quoted.

CHAPTER 96, SESSION LAWS OF 1901.

AS AMENDED IN 1903 AND 1905.

“Any town not maintaining a high school or school of corresponding grade shall pay for the tuition of any child who with parents or guardian resides in said town

and who attends a high school or academy in the same or another town or city in this state, and the parent or guardian of such child shall notify the school board of the district in which he resides of the high school or academy which he has determined to attend; *provided, however,* that no town shall be liable for tuition of a child in any school, in excess of the average cost per child of instruction for the regularly employed teachers of that school and the cost of text-books, supplies, and apparatus during the school year preceding, nor in any case, shall the town be liable for tuition for any child in excess of forty dollars per year.

“If any town in which a high school or school of corresponding grade is not maintained, neglects or refuses to pay tuition as provided in the preceding section, such town shall be liable therefor to the parent or guardian of the child furnished with such tuition, if the parent or guardian has paid the same, or to the town or city furnishing the same in an action of contract.

“Eight thousand dollars shall be appropriated annually from the state treasury for the payment of tuition in high schools and academies, to be paid by the state treasurer in the month of December of each year to the treasurers of such towns as are entitled, and in such manner as is hereinafter provided, upon a sworn certificate of the superintendent of public instruction, of the sums due.

“Towns whose rate of taxation for school purposes in any year is \$3.50 or more on \$1,000, and whose average rate of taxation for all purposes for five years next preceding is \$16.50 or more on \$1,000, shall receive a share of said appropriation as follows:

“If the tax rate is from \$16.50 to \$17.49, one-tenth of the tuition paid.

“If the tax rate is from \$17.50 to \$18.49, two-tenths of the tuition paid.

“If the tax rate is from \$18.50 to \$19.49, three-tenths of the tuition paid.

“ If the tax rate is from \$19.50 to \$20.49, four-tenths of the tuition paid.

“ If the tax rate is from \$20.50 to \$21.49, five-tenths of the tuition paid.

“ If the tax rate is from \$21.50 to \$22.49, six-tenths of the tuition paid.

“ If the tax rate is from \$22.50 to \$23.49, seven-tenths of the tuition paid.

“ If the tax rate is from \$23.50 to \$24.49, eight-tenths of the tuition paid.

“ If the tax rate is from \$24.50 to \$25.49, nine-tenths of the tuition paid.

“ Over \$25.49, the whole of such tuition.

“If more than \$8,000 should be needed in any year for the purposes of this act, the said \$8,000 shall be distributed pro rata to the towns entitled to receive the same, in accordance with the foregoing classification.

“By the term “high school” or “academy,” as used in this act, is understood a school having at least one course of not less than four years, properly equipped and teaching such subjects as are required for admission to college, technical school, and normal school, including reasonable instruction in the constitution of the United States and in the constitution of New Hampshire, such high school or academy to be approved by the state superintendent of public instruction as complying with the requirements of this section. And said superintendent is authorized to approve a school maintaining any part of such course, for the part so maintained.

“Towns paying tuition of scholars in high schools or academies shall receive a proportionate share of the literary fund for the attendance of such pupils. All academies and private schools shall be furnished with copies of the school register, and shall make annual statistical report to the state superintendent.

“Any school district may make contracts with any academies or high schools or other literary institutions located in the state for furnishing instruction to its scholars,

and such school district may raise and appropriate money to carry into effect any contracts in relation thereto.

“Every such academy or high school or literary institution shall then be deemed a high school maintained by such district, if approved by the superintendent of public instruction in accordance with section 4 of this act.”

CONDITIONS OF APPROVAL.

Approval of high schools and academies under the law of 1901, by the superintendent of public instruction, is in substance a certification by that officer that the schools approved are of the standard specified by law. The law prescribes that they shall be of college-preparatory grade, that is, that they shall teach those subjects commonly accepted as college admission requirements, and teach them with that degree of efficiency which will adequately prepare students for admission to college.

Schools will not ordinarily be approved which fail to fulfill the following minimum requirements for approval:

1. The teachers of the school must have received an education qualifying them to prepare others for higher institutions, that is to say, teachers in approved secondary schools must hold a bachelor's degree, or for the purposes of the school the full equivalent. This requirement will not be held to apply to teachers already in service in schools which have been already approved.

2. A sufficient corps of teachers must be employed so that no teachers will be obliged to teach more than eight periods per day. This is regardless of the number of curricula approved.

3. A regular program of studies calculated to fulfill the intention of the law must be adopted by the school board or the trustees of the institution and, after approval, such program may not be changed without express approval in writing of the state superintendent. A deviation from the adopted program will be considered by the superintendent as a change in the program.

4. The program of the approved school may not include subjects which belong essentially to the elementary school. Just so far as it does include such subjects, it tends to become a common school and not such a school as is contemplated by the law.

5. Reasonable instruction in the constitution of the United States and in the constitution of New Hampshire is required by law. Such a course is required of every pupil. The superintendent will consider a year's work in the history and government of the United States and of New Hampshire to be reasonable instruction. Such a course may well be given in the senior year when pupils have gained a desirable maturity. It would then be a course regularly accepted by the colleges for admission.

6. The law requires that such school shall be properly equipped. The school must possess:

- (1) An adequate supply of suitable text-books.
- (2) An adequate supply of reference books. This may be taken to mean at least:
 - (a) One or more good unabridged English dictionaries.
 - (b) One or more good unabridged lexicons for each foreign language offered.
 - (c) Either a good encyclopedia, or a good advanced treatise for each course in history and science offered.
- (3) A sufficient supply of wall maps for each course in history and science offered.
- (4) A sufficient laboratory equipment for individual work by pupils in each of the sciences, physics, chemistry, and biology, if offered.

7. The school must establish and maintain an adequate standard of admission requirements. All pupils entering from beyond the district limits, from without the jurisdiction of the governing body of the school, that is to say those commonly known as "tuition pupils," may be admitted only upon written examination in spelling, Eng-

lish composition, English grammar, history of the United States, arithmetic, geography, and physiology and hygiene, the last with special reference to the effects of the use of narcotics and alcoholic stimulants. The governing body must establish and maintain some regular and adequate rules of admission for pupils coming from schools within its own jurisdiction, as for instance, pupils entering a high school from a grammar school.

8. The governing body must establish and maintain some regular and adequate rules of promotion from class to class within the school.

9. The governing body must maintain a proper state of discipline within the school. A school cannot fairly be said to be capable of preparing for college except it be conducted in good order.

CHAPTER I.

CURRICULA.

An approved high school or academy may have a program made up of one or more of the curricula outlined below, or it may combine or modify the same to suit its own needs subject to the approval of the state superintendent. It may choose one or more curricula not covered in the list here given, provided the courses thereof are of recognized secondary grade, and provided the curricula selected can be so adjusted as to be of equivalent educational value with those here given.

A small school properly equipped and duly approved, working on a program of but one curriculum is considered by the department to be equal in standard to the large school working on a program of many curricula.

History may be either ancient, mediæval and modern, English, United States, or any of them.

Mathematics review may be either a review of algebra and geometry, or these with the addition of arithmetic review, or arithmetic alone, review and advanced. It is recommended that the needs of each class determine the decision.

Advanced mathematics may be any two of the following group according to the needs of the class:

Advanced arithmetic, advanced algebra, solid geometry, trigonometry and surveying.

It is assumed that for administrative purposes, algebra, geometry, advanced and review mathematics, English, history, modern language in different curricula, will usually be combined in the same classes.

Year	CURRICULUM I			CURRICULUM II			CURRICULUM III			CURRICULUM IV		
	COURSE	Extent Week	Periods per Week	COURSE	Extent Week	Periods per Week	COURSE	Extent Week	Periods per Week	COURSE	Extent Week	Periods per Week
I	Latin	5	Year	Latin	5	Year	Latin	5	Year	Biology	5	Year
	Algebra	5	"	Algebra	5	"	Algebra	5	"	Algebra	5	"
	English	5	"	English	5	"	English	5	"	English	5	"
	History	5	"	History	5	"	History	5	"	History	5	"
II	Latin	5	"	Latin	5	"	Latin	5	"	History	5	"
	Greek	5	"	Modern Language	5	"	Modern Language	5	"	Modern Language	5	"
	Geometry	5	"	Geometry	5	"	Geometry	5	"	Geometry	5	"
	English	5	"	English	5	"	English	5	"	English	5	"
III	Latin	5	"	Latin	5	"	Physics	5	"	Physics	5	"
	Greek	5	"	Modern Language	5	"	Modern Language	5	"	Modern Language	5	"
	English	5	"	English	5	"	English	5	"	English	5	"
	Physics	5	"	Physics	5	"	Mathematics Rev.	5	"	Mathematics Rev.	5	"
IV	Latin	4	"	Latin	4	"	Chemistry	4	"	Chemistry	4	"
	Greek	4	"	Modern Language	4	"	Modern Language	4	"	Modern Language	4	"
	English	4	"	English	4	"	English	4	"	English	4	"
	American History	4	"	American History	4	"	American History	4	"	American History	4	"
Mathematics Rev.	4	"	Mathematics Rev.	4	"	Adv. Math'matics	4	"	Adv. Math'matics	4	"	

CURRICULUM VII

CURRICULUM VI

CURRICULUM V

Year	COURSE	Extent Weeks	Periods per Week	COURSE	Extent Weeks	Periods per Week	COURSE	Extent Weeks	Periods per Week	
I	Algebra	5	5	Algebra	5	5	Algebra	5	5	
	English	5	5	English	5	5	English	5	5	
	History	5	5	Book-keeping	5	5	Book-keeping	5	5	
	Mechanical Drawing	5	5	Biology	5	5	Com. Arithmetic	5	5	
	(a) Joinery	} 10	}	Drawing	5	5	Com. Geography	5	5	
	(b) Carpentry					Penmanship	1	1		
	(c) Carving									
	II	English	5	5	English	5	5	English	5	5
		Geometry	5	5	Geometry	5	5	Geometry	5	5
		Modern Language	5	5	Physics	5	5	Book-keeping and office	5	5
Mechanical Drawing		5	5	Horticulture	5	5	Modern Language	5	5	
III	(a) Wood-turning	} 10	}	Agriculture	5	5				
	(b) Pattern-making									
	(c) Molding and casting									
	(d) Forging									
IV	English	5	5	English	5	5	English	5	5	
	Physics	5	5	Chemistry	5	5	Physics or Chemistry	5	5	
	Modern Language	5	5	Comparative Physiology	5	5	Modern Language or	5	5	
	Mechanical Drawing	5	5	Rural Engineering	5	5	Stenography and	5	5	
	Machine work	} 10	}	Modern Language	5	5	writing	5	5	
	(a) Hand tools					History of Commerce	5	5	Political Economy	5
V	(b) Machine tools									
	English	4	4	English	4	4	English	4	4	
	American History	4	4	American History	4	4	American History	4	4	
	Chemistry	4	4	Modern Language	4	4	Commercial Law	4	4	
	Modern Language	4	4	Rural Economy and Farm	2	2				
	Mechanical Drawing	4	4	Management	2	2				
VI	(a) Tool-making	} 10	}	Animal Husbandry and	5	5				
	(b) Machine-shop practice					Dairying				
VII				Modern Language	4	4	Modern Language	4	4	
				Stenography and	4	4	Stenography and	4	4	
				Typewriting	4	4	Typewriting	4	4	
				Adv. Mathematics	4	4	Adv. Mathematics	4	4	
				Physics or Chemistry	4	4	Physics or Chemistry	4	4	
				Elements of Banking and	4	4	Elements of Banking and	4	4	
				Finance	4	4	Finance	4	4	
				Adv. Com. Arithmetic	4	4	Adv. Com. Arithmetic	4	4	
				Advertising and Study of	4	4	Advertising and Study of	4	4	
				Trade Journals	4	4	Trade Journals	4	4	
			Office work for Stenographers	4	4	Office work for Stenographers	4	4		

Elect 8 periods for 1st and 12 periods for 2d Semester from the following:

CHAPTER II.

ENGLISH.

English teaching in the secondary school contemplates several specific aims, chief among which are cultivation in the pupil of literary taste, and the competency of the pupil in English composition. Each of the four years should therefore include a five period course in English language and literature. For convenience of administration, this document will assume that on the average about three periods per week will usually be devoted to literature and two periods to composition or language study, but it is understood that the teacher will find it convenient, from time to time, to vary largely the relative proportion of time devoted to the two sides of the subject.

In each year lists of books are suggested, but it must be understood that these lists will need to be varied from time to time, and therefore must be taken as illustrative rather than prescriptive.

FIRST COURSE.

LITERATURE.

It is recommended that the work of this year both in literature and in composition be centered in the Narrative.

Classroom readings with study, six books for the year as a minimum.

Scott's *Ivanhoe*.

Dickens' *Tale of Two Cities*.

Byron's *Prisoner of Chillon and Mazeppa*.

Palmer's *Translation of the Odyssey*.

Coleridge's *Ancient Mariner*.

Supplementary outside readings, six books for the year as a minimum. Select at least one from each group.

- I. Scott's *Lady of the Lake*,
Longfellow's *Courtship of Miles Standish*,
Scott's *Kenilworth*.
- II. Hawthorne's *Twice Told Tales*,
Macauley's *Lays of Ancient Rome*,
Irving's *Tales of a Traveler*.
- III. Dana's *Two Years Before the Mast*,
Irving's *Sketch Book*,
Cooper's *Deerslayer or Pilot*.
- IV. Cooper's *Last of the Mohicans*,
Kipling's *Jungle Books*, 1 and 2,
Scott's *The Talisman*.
- V. Aldrich's *Bad Boy*,
Warner's *Being a Boy*,
Burrough's *Sharp Eyes*.
- VI. Dodge's *Hans Brinker*,
Whittier's *Snow Bound*,
Hale's *A Man Without a Country*.

The teacher should assist the pupil in the selection of books and should require evidence, by reports or by class discussion, on books which are read outside of school.

COMPOSITION AND RHETORIC.

It is recommended that the backbone of this side of the work of this year and the next be a suitable formal text-book on rhetoric and composition.

Themes.

Students should have constant exercises in the writing of short themes. Such themes should be revised and corrected by the teacher, and often in the class by class criticism. An entire theme should occasionally be placed upon the board, criticised, and rewritten by the class. Criticism of themes by the teacher should be constructive and

positive, while, of course, it must constantly be concerned with questions of grammar, spelling, punctuation, capitalization, etc.

Attention is particularly called to these three points.

(1) Themes should not be so many that the teacher cannot thoroughly revise them. One short theme a month thoroughly revised and corrected by teacher and pupil is far better than a multitude which cannot be properly overlooked without unduly burdening the teacher, and staling the class.

(2) Papers in other subjects, especially the sciences and foreign languages, should frequently be used as themes and treated as such.

(3) Teachers of other subjects must constantly insist on the use of correct idiomatic English in papers taken up by them; and upon the use of oral recitations as an unexcelled opportunity for inculcating the use of good English.

The following work is suggested as the basis of theme writing. The atmosphere of the year in composition as well as in literature should be in the main Narration.

I. Letter writing.

II. Short themes, both oral and written, based on the experience of the pupil, as well as on the literature of the term.

III. Short themes, imaginative in character, in the form of the short story.

Emphasis should be laid, first, last, and all the time, upon reading aloud, with clearness and force; and upon the use of good English in oral recitation. Interest in theme writing and in composition and rhetoric may be aroused by a class paper edited by the class and finally read aloud by the members of the class on the last Friday of the month.

GENERAL RESULTS OF THE YEAR'S WORK.

At the end of the first year in the secondary school, pupils should be on familiar terms with the correct use of

capitals, punctuation and grammar, and the spelling of the mother tongue. Thereafter, ordinary errors in these matters should be held to be inexcusable. Pupils should have read, discussed and written upon some of the world's best narratives, especially English and American romances, and other fiction. They should thoroughly understand the elements of the paragraph and the unity of the short theme.

SECOND COURSE.

LITERATURE.

It is recommended that the work of this year, both in literature and in composition, be centered largely in Description.

Classroom reading with study, six books for the year as a minimum.

Scott's Marmion,
 Shakespeare's Julius Cæsar,
 Shakespeare's Twelfth Night,
 Shakespeare's Merchant of Venice,
 Eliot's Silas Marner,
 Browning's Cavalier Tunes,
 The Lost Leader,
 How They Brought the Good News from
 Ghent to Aix,
 Evelyn Hope,
 Home Thoughts from Abroad,
 Home Thoughts from the Sea,
 Incident of the French Camp,
 The Boy and the Angel,
 One Word More,
 Herve Riel,
 Pheidippides.

Much interest may be aroused by the occasional reading by the teacher of lyrics from Palgrave's Golden Treasury, Series II and III, from Gray, Cooper, Goldsmith and Burns.

Supplementary outside readings, six books for the year as a minimum. Select at least one from each of the following groups.

- I. Gray's *Elegy*,
Goldsmith's *Deserted Village and Traveler*,
Warner's *Backlog Studies*.
- II. Stevenson's *Kidnapped*,
Muloch's *John Halifax*,
Hughes' *Tom Brown at Oxford*.
- III. Stockton's *Rudder Grange*,
Mark Twain's *Tom Sawyer*,
Mark Twain's *Huckleberry Finn*.
- IV. Blackmore's *Lorna Doone*,
Scott's *Guy Mannering*,
Dickens' *David Copperfield*.
- V. Roosevelt and Lodge: *Hero Tales from American History*,
Roosevelt's *Ranch Life and the Hunting Trail*,
London's *The Call of the Wild*.
- VI. Eggleston's *The Hoosier Schoolmaster*,
Gaskell's *Cranford*,
Dickens' *Nicholas Nickleby*.

The teacher should assist the pupil in the selection of books and should require evidence, by reports or by class discussion, on books which are read outside of school.

COMPOSITION AND RHETORIC.

It is recommended that the backbone of this side of the work in this year be a continuation of the work of the preceding year in the study of a suitable formal text-book on rhetoric and composition. The same text may be used as in the preceding year or another text supplementary to the first may be selected.

Themes.

The atmosphere of the subject matter of themes as well as of literature should be in the main Description.

The teacher should read carefully all that is laid down under this general head in the first course.

GENERAL RESULTS OF THE SECOND COURSE.

The pupil should at the end of the second year possess an appreciation of the main characteristics of the more important literary types of the descriptive mood and the drama. He should understand the principles of the paragraph and the functions of unity, coherence and proportion. No special attention ought to be given to instruction in common errors in punctuation, spelling, etc. The pupil should be held rigorously responsible for these matters without instruction.

THIRD COURSE.

LITERATURE.

The general purpose of teaching literature in the third year is to secure clearness of thought from reading fine standards of exposition, essays, lyrics, the drama and argumentation; further, the study of literature should begin to develop the power of discrimination in the comparison of literary values in a simple way and to stimulate a finer feeling for literature.

Classroom reading with study, six books for the year as a minimum.

- I. Addison's DeCoverly Papers,
- II. Tennyson's Idylls, Lancelot and Elaine, Gareth and Lynette, Passing of Arthur.
- III. Arnold's Sohrab and Rustum.
- IV. Ruskin's Sesame and Lilies.
- V. Hawthorne's House of the Seven Gables.
- VI. Macaulay's Lord Clive.

Supplementary outside readings, at least six books to be read during the year. Choose at least one from each group.

- I. DeQuincey's Joan of Arc, and the English Mail Coach,
Kingsley's Roman and Teuton,
Webster's First Bunker Hill Oration.
- II. Wallace's Ben Hur,
Kingsley's Hypatia,
Eber's Uarda.
- III. Goldsmith's Vicar of Wakefield,
Thackeray's Henry Esmond,
Irving's Legend of the Alhambra.
- IV. Lamb's Essays of Elia,
Holmes' Autocrat of the Breakfast Table,
Emerson's Conduct of Life.
- V. Shakespeare's Henry V,
Shakespeare's Richard III,
Bunyan's Pilgrim's Progress,
Pope's Rape of the Lock.
- VI. Irving's Life of Goldsmith,
Roosevelt's Winning of the West,
Craddock's Prophet of the Great Smoky Mountains.

The teacher should assist the pupil in the selection of books and should require evidence, by reports or by class discussion, on books which are read outside of school.

COMPOSITION AND RHETORIC.

The basis of this side of the work for this year should be a suitable text in somewhat advanced English grammar.

Themes.

The effort of this year should be centered upon Exposition and Argumentation, just as the work of the preceding years has centered upon narration and description. The teacher will probably find it useful to utilize the natural interest in debate for this purpose.

One theme of some length should be written occasion-

ally, carefully developed from an outline, and requiring some research.

The attention of the teacher is particularly called to remarks under this heading in the first course.

GENERAL RESULTS OF THE THIRD COURSE.

The third year introduces the pupil to some of the world's greatest essays, to general expository writing, to a clear and definite expression of one's ideas.

It must be understood that common errors have been eliminated, and in general, no pupil should be admitted to the work of this year who is not competent in this direction. If the secondary school will be a kindergarten it will assuredly have to be. Therefore it should finally decline to be a kindergarten.

Finally the pupil should begin to appreciate the power of carefully organized writing and the power of words which are carefully and effectively chosen.

FOURTH COURSE.

The general purpose of this year is a review of the whole of English and American literatures, of great movements in literature, of periods of thought, like the Elizabethan and Queen Anne periods. This review may be founded upon such manuals and epitomes as Symond's or Halleck's History of English Literature, Matthew's or Newcomer's American Literature, and such handbooks as George's Chaucer to Arnold or Scudder's Masterpieces of American Literature, with readings from collections of verse like Palgrave's Golden Treasury.

Classroom reading with study, six books as a minimum.

- I. Milton's Minor Poems, L'Allegro, Comus, Lycidas, Il Penseroso.
- II. Shakespeare's Macbeth.
- III. Burke's Conciliation or Essay on Addison.
- IV. Milton's Paradise Lost.
- V. Emerson's Essays, selected.

VI. Macaulay's Life of Johnson or Carlyle's Burns.

In addition to the above:

Washington's Farewell Address and Lincoln's Gettysburg Address should be thoroughly read by every pupil, and so far as possible committed.

This may be done, if desired, in connection with senior course in American history.

Supplementary readings, six books for the year as a minimum. Select at least one from each of the following groups.

- I. Shakespeare's Hamlet,
Shakespeare's As You Like It,
Eliot's Romola.
- II. Warner's My Summer in a Garden,
Thoreau's Walden,
Hawthorne's The Marble Faun.
- III. Rope's Napoleon,
Shurz's Abraham Lincoln,
Riis' How the Other Half Lives.
- IV. Thackeray's The Newcomes,
Eber's An Egyptian Princess,
Scott's Quentin Durward.
- V. Carlyle's Heroes and Hero Worship,
Bacon's Essays.
- VI. Spenser's Faerie Queen,
Chaucer's Prologue and Knight's Tale.

Reports of the outside reading should be full and complete with some evidence of discrimination in the selection of books.

The teacher may, with profit, read to the class selections from Anglo-Saxon, such as Beowulf, and so down through the great epochs of English and American literature to the present.

COMPOSITION AND RHETORIC.

The general work of the year, which should not require more than one period per week, may properly be themes reviewing the principles of four years' work.

An important part of the work may well be a period, say once in two weeks, when one or more pupils speak before the class on some subject which each has chosen and studied. Finally a composition should be written, for which the student should have perfect freedom in his choice of literary form, and in which he ought to express himself correctly and forcibly in clear, idiomatic English. This production should be a fair test of his ability to write, and might be written on the last Friday of each term of the fourth year.

CHAPTER III.

LATIN.

FIRST COURSE.

Beginner's Book and Easy Reading.

The translation of English into Latin should be carried on from the beginning.

Sight translation should be encouraged from the first, and, if possible, the formation of the lexicon habit avoided.

Easy reading from *Fabulæ Faciles*, *Viri Romæ*, *Nepos*, or similar work, should be commenced as early as possible and carried on parallel with study of the beginner's book.

Results.

Complete mastery of the forms of the beginner's book.

Vocabulary of 700 to 800 words, each at tongue's end.

Accurate pronunciation by Roman method.

Familiarity with a few fundamental principles of syntax.

Intelligent reading aloud of easy Latin.

Ability to translate the simplest Latin prose into English without the aid of lexicon, some of the easier stories in gradatim for instance.

Facility in translating simple English sentences into Latin.

SECOND COURSE.

Cæsar's Commentaries: Gallic War, I to IV; and as much of V to VIII at sight as possible.

Latin prose composition based on Latin read, continuous narrative.

Sight reading daily, usually of the text in the hands of pupils. Aim to develop the power of reading Latin in the senior year as the senior reads French.

Oral prose composition, daily, based on review translation.

Historical geography of the work being studied.

Study of Cæsar's life and position at Rome, and review of the Roman history of the period.

Results.

Mastery of the syntax of Cæsar, especially the indirect discourse and use of the subjunctive.

Ability to read without lexicon, after brief preparation, the ordinary Latin of Cæsar.

Ability to read aloud intelligently, without translation, any review Latin.

Ability to turn into Latin easy English prose based on Cæsar.

All translations to be into correct idiomatic English.

THIRD AND FOURTH YEARS.

No distinction is made between these years as such, since no preference is given to the order in which Cicero, Ovid and Virgil should be read.

Cicero's Orations.

The four Catilian orations and three others. The oration on the Manilian Law will count as two.

Latin prose composition based on Latin read, continuous narrative.

Sight reading as in second year.

Oral prose composition, daily, based on review.

Review and study of Roman history of the period covered by the orations.

Sallust's *De Coniuratione Catilinæ* might very well be read at sight.

Study of exposition and argumentation as used by Cicero, correlated with regular English work of this year.

Every translation should be into correct idiomatic English.

Ovid's *Metamorphoses*.

Selections aggregating at least 1,500 lines.

Latin prose composition based on grammatical review.

Sight reading frequently. It is recommended that some other than the text under treatment be used. Additional Cicero might be read, or Cæsar, or Sallust, or other authors of the same period.

Principles of Latin poetry and metrical rendering of text read.

Study of mythology treated by the poet and some account of Ovid and his place in the Augustan Age.

Every translation should be into correct idiomatic English.

Virgil's Aeneid.

Books I to VI or not less than 4,500 lines.

Latin prose composition based on either Cicero, Cæsar, or grammatical review.

Daily sight reading of the text. It ought to be possible, if Virgil is the last Latin to be read, to read a large part of Books VII to XII at sight.

Study of prosody and metrical rendering of the text read.

The historical setting of the poem, and some study of the heroic age of which it treats.

Every translation to be into correct idiomatic English.

IN GENERAL.

The study of Latin is of little use if it does not produce certain powers in the student. Such powers are hard to measure in themselves, but reasonable assurance can be felt that the pupil possesses them, provided he shows at the end of his school career the following abilities:

1. To read the Latin of the authors studied, both those portions which have been read and those which have not, without dependence upon a lexicon.
2. To turn Latin into idiomatic English.
3. To turn English into idiomatic Latin.
4. To read any Latin of the authors studied aloud in the original in such wise that his expression will reveal a true sense of the meaning of that which he reads.

CHAPTER IV.

GREEK.

FIRST COURSE.

(See also Latin.)

The Beginner's Book, Easy Reading, and the Anabasis begun.

Greek prose composition last half of spring term.

Sight translation should be begun as early as possible and encouraged, and contraction of the lexicon habit avoided.

Easy reading should be begun as soon as possible and carried on parallel with the beginner's book. In the latter half of the spring term, the Anabasis should be commenced with daily lessons, and prose composition, continuous narrative, based on the Anabasis, carried on parallel with the same.

Results.

Substantial attainment in the command of forms.

Vocabulary of the beginner's book mastered and at the tongue's end.

Accurate pronunciation and thorough understanding of the principles of accent.

Thorough understanding of the *fundamental* principles of syntax.

Ability to translate simplest Greek without the aid of a lexicon.

Facility in rendering short and simple English sentences into Greek.

SECOND COURSE.

The Anabasis, four books, complete.

Greek prose composition based on the Anabasis, continuous narrative.

Sight translation daily, usually from the text. If possible, books V to VII should be read in this way, or, towards the end of the year, selections from the Hellenica. See second-year Latin.

Oral prose composition, daily, based on review translation.

Study of syntax, grammar, and forms.

Study of historical geography, and review of the phase of Greek history treated in the Anabasis.

Results.

Mastery of the forms of Attic Greek.

Mastery of the syntax used by Xenophon.

Ability to read without aid of lexicon, after brief preparation, the ordinary Greek of Xenophon.

Ability to read aloud intelligently any review Greek without translation.

Ability to turn into Greek, without aid of reference books, easy English prose based on Xenophon.

THIRD COURSE.

Homer's Iliad, Books I to III, or 1,500 lines of the Homeric poems.

Greek prose composition based on grammatical study.

Daily sight reading of the text. It ought to be possible to read at sight a considerable portion of either the Iliad or the Odyssey beyond the minimum requirement.

Study of prosody and metrical rendering of the poem. The peculiarities of Homeric Greek, in form, syntax and prosody.

The historical setting of the poem and some study of the heroic age which it treats.

General Results.

See Latin, Chapter III, to which attention is particularly called.

CHAPTER V.

FRENCH.

FIRST COURSE.

During the first year the work should comprise: (1) careful drill in pronunciation; (2) the rudiments of grammar, including the inflection of the regular and the more common irregular verbs, the plural of nouns, the inflection of adjectives, participles, and pronouns; the use of personal pronouns, common adverbs, prepositions, and conjunctions; the order of words in the sentence, and elementary rules of syntax; (3) abundant easy exercises designed not only to fix in the memory the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression; (4) the reading from 125 to 200 duodecimo pages of graduated texts, with constant practice in translating into French easy variations of the sentences read (the teacher giving the English), and in reproducing from memory sentences previously read; (5) writing French from dictation.

SECOND COURSE.

During the second year the work should comprise: (1) the reading of from 300 to 500 pages of easy modern prose in the form of stories, plays, or historical or biographical sketches; (2) constant practice, as in the previous year, in translating into French easy variations upon the texts read; (3) frequent abstracts, sometimes oral, and sometimes written, of portions of the text already read; (4) writing French from dictation; (5) continued drill upon the rudiments of grammar, with constant application in the construction of sentences; (6) mastery of the forms

and use of pronouns, pronominal adjectives, of all but the rare irregular verb forms, and of the simpler uses of the conditional and subjunctive.

Material suitable for the first two courses may be selected from the following list:

- Bruno, *Le Tour de la France*.
 Daudet, *Trois Contes Choisis*.
 Dumas, *Excursions sur les bords du Rhin*, *La Tulipe Noire*.
 Ereckmann-Chatrion, *Madame Therese*, *Le Consercit*.
 Foncin, *Le pays de France*.
 Halévy, *L'Abbé Constantin*.
 Labiche et Martin, *La poudre aux yeux*, *Le voyage de M. Perrichon*.
 Legouvé et Labiche, *La Cigale chez les fourmis*.
 Meilhac et Halévy, *L'été de la St. Martin*.
 Malot, *Sans famille*.
 Mérimée, *Colomba*.
 Sand, *La Mare au diable*.
 Saintine, *Picciola*.
 Voltaire, *Zadig*.

Results.

At the end of the first two courses, the pupil should be able to pronounce French accurately, to read at sight easy French prose, to put into French simple English sentences taken from the language of every day life, or based upon a portion of the French text read, and to answer questions on the rudiments of the grammar as defined above.

THIRD COURSE.

This course should comprise the reading of from 500 to 700 pages of French of ordinary difficulty, a portion to be in the dramatic form; constant practice in giving French paraphrases, abstracts or reproductions from memory or

selected portions of the matter read; the study of a grammar of moderate completeness; writing from dictation.

The following are suitable texts:

About, *La mère de la Marquise*, *Le roi de Montagnes*.

Augier et Sandeau, *Le gendre de M. Poirier*.

Beranger, Selected poems.

Coppée, Selected poems.

Daudet, *Le Petit Chose*, *La Belle Nivernaise*.

Dumas, *Les trois mousquetaires*, *Monte Christo*.

Hugo, *La Chute*.

Labiche, *La Cagnotte*.

La Fontaine, Fables.

Lamartine, *Jeanne D'Arc*, *Scènes de la Révolution*.

Francaise.

Loti, *Pêcheur d'Islande*, *Ramuntcho*.

Molière, *L'Avare*, *Le bourgeois gentilhomme*.

Racine, *Athalie*, *Esther*.

Sand, *La petite Fadette*.

Sarcey, *Le Siècle de Paris*.

Souvestre, *Le Serf*, *Le Mari de Mme. de Solange*.

Results.

At the end of the third course the pupil should be able to read at sight ordinary French prose or simple poetry, to translate into French a connected passage of English based on the text read, and to answer questions involving a more thorough knowledge of syntax than is expected in the elementary course.

CHAPTER VI.

GERMAN.

FIRST COURSE.

During the first year the work should comprise:

1. Careful drill upon pronunciation.
2. The memorizing and frequent repetition of easy colloquial sentences.

3. Drill upon the rudiments of grammar, that is, upon the inflection of articles, of such nouns as belong to the language of everyday life, of adjectives, pronouns, weak verbs; also upon the use of the more common prepositions, the simpler uses of the modal auxiliaries, and the elementary rules of syntax and word order.

4. Abundant easy exercises designed not only to fix in mind the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression.

5. The reading of from 75 to 100 pages of graduated texts from a reader, with constant practice in translating into German easy variations upon sentences selected from the reading lesson (the teacher giving the English), and in the reproduction from memory of sentences previously read.

6. Writing German from dictation.

SECOND COURSE.

During the second year the work should comprise:

1. The reading of from 150 to 200 pages of literature in the form of easy stories and plays.

2. Accompanying practice, as before, in the translation into German of easy variations upon the matter read, and also in the off-hand reproduction, sometimes orally and

sometimes in writing, of the substance of short and easy selected passages.

3. Continued drill upon the rudiments of the grammar, directed to the ends of enabling the pupil, first, to use his knowledge with facility in the formation of sentences, and, secondly, to state his knowledge correctly in the technical language of grammar.

Suitable material for reading in the first two courses may be selected from the following :

Anderson, Märchen, Bilderbuch ohne Bilder.

Arnold, Ein Regentag auf dem Lande, Fritz auf Ferien.

Auerbach, Brigitta.

Benedix, Der Prozess, Der Weiberfeind, Nein, Einer Muss heiraten.

Elz, Er ist nicht eifersüchtig.

Hauff, Das Kalte Herz, Tales.

Heyse, Anfang und Ende, Niels mit der offenen Hand.

Hillern, Höher als die Kirche.

Jensen, Die braune Erica.

Leander, Traumereien.

Lohmeyer, Der Geissbub von Engleberg.

Schiller, Der Neffe als Onkel.

Seidel, Märchen, Leberecht Hünchen.

Spyri, Moni der Geissbub.

Stern, Geschichten vom Rhein.

Stokl, Unter dem Christbaum.

Storm, Immensee, Geschichten aus der Tonne, Pole Poppenspärer.

Volkmann, Kleine Geschichten.

Wichert, An der Majorsecke.

Wildenbruck, Das edle Blut.

Zschokke, Der zerbrochene Krug, Das Wirtshaus zu Cransac, Das Abenteuer der Neujahrsnacht.

Results.

At the end of the first two courses in German, the pupil should be able to read at sight, and to translate, if called

upon, by way of proving his ability, to read a passage of very easy dialogue or narrative prose, help being given upon unusual words and constructions; to put into German short English sentences taken from the language of everyday life or based upon the text given for translation, and to answer questions upon the rudiments of grammar, as defined above.

THIRD COURSE.

The work should comprise, in addition to the first two courses, the reading of about 400 to 450 pages of moderately difficult prose and poetry, with constant practice in giving sometimes orally and sometimes in writing, paraphrases, abstracts, or reproductions from memory of selected portions of the matter read; also grammatical drill upon the less usual strong verbs, the use of article, cases, auxiliaries of all kinds, tenses and modes (with special reference to the infinitive and subjunctive) and likewise upon word order and word formation. Continue writing from dictation.

Material for the third course may be selected from the following list:

- Baumbach, Die Nonna, Der Schwiegersohn, Das Habichtsfräulein.
- Ebner-Eschenbach, Die Freiherren von Gemperlein.
- Freytag, Die Journalisten, Karl der Grosse, Aus den Kreuzzügen.
- Freytag, Aus dem Staat Friedrichs des Grossen.
- Fouqué, Undine.
- Goethe, Hermann und Dorothea, Das Märchen.
- Heine, Poems, Reisebilder.
- Heyne, L'Arrabbiata, Das Mädchen von Treppi.
- Hoffmann, Historische Erzählungen.
- Keller, Kleider Machen Leute.
- Lessing, Minna von Barnhelm.
- Meyer, Gustave Adolfs Page.
- Moser, Der Bibliothekar.

Riehl, Burg Neideck, Der Fluch der Schönheit, Der
Stumme Ratsherr, Das Spielmannskind.

Rosséger, Waldheimat.

Schiller, Die Jungfrau von Orleans, Das Lied von der
Glocke, Balladen.

Scheffel, Der Trompeter von Sakkingen.

Seiden, Herr Omnia.

Uhland, Poems.

Results.

At the end of the third course, the pupil should be able to read at sight German prose of ordinary difficulty, whether recent or classical; to put into German a connected passage of simple English, paraphrased from a given text in German; to answer any grammatical questions relating to usual forms and essential principles of the language, including syntax and word formation, and to translate and explain (so far as explanation may be necessary) a passage of classical literature taken from some text previously studied.

CHAPTER VII.

HISTORY.*

Too much stress cannot be placed upon the study of history as a factor in secondary school work. By this is meant, not the study of history with a single text-book, whose contents are to be learned as memory exercises, but the study which makes of history an almost unequalled means for the development of the reasoning powers and the ability to judge aright, and the fitting of the student for the demands of intelligent citizenship.

The *objects* of history teaching are:

To give at least an elementary idea of the steps in the development of the intellectual and material resources of the world.

To gain an appreciation of the law of cause and effect, as manifested in the current of human affairs.

To give some realization how the increasing needs of civilized man have been met by new discoveries of natural resources and by new inventions of man.

To impress upon the student the relations of the individual to the state, of the state to the individual.

To aid in the development of general culture and in the broadening of one's life's horizon.

To develop some taste for research, and the ability to extract truth from storehouses of mingled fact and fancy.

ANCIENT HISTORY.

I. THE ORIENTAL NATIONS.

1. Introduction: Scope and Course of Ancient History.
2. Egypt, 5000-525 B. C.

*The syllabi under this chapter are quoted direct from "A History Syllabus for Secondary Schools," prepared by a committee of the New England History Teachers' Association, D. C. Heath & Co., 1904, which see. The syllabi are designed to indicate the scope and proportion of instruction in an approved school.

3. The Tigris-Euphrates Valley, 5000, or earlier, to 538 B. C.
4. Syria (I) The Phœnicians.
5. Syria (II) The Hebrews.
6. Media and Persia, 850(?) - 514 B. C.
7. Summary and Review of the Oriental Nations.

II. ANCIENT HELLAS: EARLY DEVELOPMENT,
2000(?) - 750 B. C.

8. The Land and the Aegean Basin.
9. The People: Migration and Expansion.
10. The Epic, or "Homeric," Age 1000-700 B. C. (approximately).
11. "Greek Reconstruction of Early History."
12. The States, and the Beginnings of Leagues.

III. STATE AND NATIONAL DEVELOPMENT IN GREECE TO THE
FOREIGN WARS, 750-500 B. C.

13. Age of Colonial Expansion.
14. Order of Political Evolution.
15. Growth of Sparta: A Military Aristocracy.
16. Growth of Athens: Progress toward Democracy.
17. Intellectual Progress of Hellas to 500 B. C.
18. Bonds of Union.

IV. FOREIGN WARS OF THE GREEKS: INDEPENDENCE,
560-479 B. C.

19. Lydian and Persian Conquests in Asia Minor.
20. Scythian Expedition and Ionic Revolt.
21. The Persian Invasion, 492-479 B. C.
22. "The Punic Invasion," 485-480 B. C.: The Carthaginians in Sicily.

V. THE PRE-EMINENCE OF ATHENS, 479-431 B. C.

23. The Delian League and the Athenian Empire, 477-461 B. C.

24. The Periclean Age and the Athenian Democracy, 461-431 B. C.
25. Intellectual Life; The Athenian Genius.

VI. A CENTURY OF STRIFE, 461-362 B. C.

26. The Athenian Attempt at Land Empire, 461-445 B. C.
27. The Peloponnesian War, 431-404 B. C.
28. The New Learning.
29. The Hegemony of Sparta, 404-371 B. C.
30. The Attempted Hegemony of Thebes, 371-362 B. C.
31. The Western Greeks, 410-300 B. C. (approximately).
32. Literature and Art, 400-350 B. C.
33. The Rise of Macedon, 359-336 B. C.

VII. THE EMPIRE OF ALEXANDER, 336-146 B. C.

34. The Career of Alexander, 336-323 B. C.
35. The Hellenistic Period, 323-146 B. C.
36. Greece, to Roman Intervention; Attempts at Federal Government, 280-200 B. C.

VIII. EARLY ROME TO ROMAN SUPREMACY IN ITALY,

753(?) - 264 B. C.

37. The Land and the People.
38. Early Rome: Sources of Our Knowledge.
39. Regal Rome: Organization.
40. The Early Republic: The Struggle between the Classes; Triumph of the Plebeians, 509(?) - 286 B. C.
41. The Early Republic: The Establishment of Rome's Supremacy in Latium, 509(?) - 338 B. C.
42. The Conquest and Organization of Italy, 338-264 B. C.

IX. ROME SUPREME IN THE MEDITERRANEAN BASIN,

264-133 B. C.

43. The Struggle with Carthage for Sicily: The First Punic War, 264-241 B. C.

44. The extension of Italy to its Natural Boundaries; Wars in Africa and Spain, 241-218 B. C.
45. The Struggle between Rome and Carthage for the Supremacy in the West: The Second and Third Punic Wars, 218-133 B. C.
46. Rome Becomes Supreme in the Eastern Mediterranean, 216-133 B. C.

X. THE ANCIENT WORLD UNDER ROMAN RULE TO 31 B. C.

47. The Organization of Rome's Foreign Conquests.
48. The Effects of Conquests and the Provincial System upon Society, Politics and Manners.
49. The Revolutionary Attempts at Reform under the Gracchi, 133-121 B. C.
50. "The Rule of the Restoration," 121-88 B. C.
51. The Struggle between Marius and Sulla; Re-establishment of Senatorial Rule, 88-79 B. C.
52. Pompey and Cæsar, 79-49 B. C.
53. The Rule of Cæsar, 48-44 B. C.
54. The Struggle for the Succession, 44-31 B. C.
55. Roman Culture in the "Ciceronian Age."

XI. THE ANCIENT WORLD UNDER THE ROMAN EMPIRE,
31 B. C. TO 375 A. D.

56. The Establishment of the Empire, 31 B. C. to 14 A. D.
57. The Julian and Flavian Cæsars, 14-96 A. D.
58. The Empire under the "Good" Emperors, 96-180 A. D.
59. The Roman Empire under the Soldier Emperors: A Century of Revolution, 180-284 A. D.
60. The Roman Empire under the Absolute Emperors, 284-375 A. D.
61. The Rise and Triumph of Christianity.

XII. THE TRANSITION PERIOD, 376-800 A. D.

62. The Invasions, and the Fall of the Western Empire, 376-476 A. D.

63. The West: Continued Invasions, and Formation of Germanic States, 476-774 A. D.
64. The East: One Emperor (Constantinople); A new Prophet, 476-732 A. D.
65. "The Rise of the Christian Church."
66. The Growth of the Frankish Power; A new Emperor, 486-800 A. D.
67. Retrospect, from the Euphrates to the Rhine.

MEDIEVAL AND MODERN EUROPEAN HISTORY.

I. THE CAROLINGIAN EMPIRE AND THE RISE OF FEUDALISM.

1. The Development of the Christian Church.
2. The Consolidation of Various German Tribes into the Frankish Kingdom, to 768.
3. The Wars and Conquests of Charlemagne.
4. The Founding of the Empire of Charlemagne, 800 A. D.
5. The Decline of the Carolingian Empire, and the Formation of Separate Monarchies.
6. The Beginnings of Feudalism.

II. THE PAPACY AND THE BEGINNING OF THE NEW GERMAN-ROMAN EMPIRE.

7. Germany and Italy, to the Death of Otto the Great, 973.
8. The Struggle over the Right of Investiture. to 1122.
9. Frederick I (Barbarossa), 1152-1190.
10. Innocent III and his Position in Christendom, 1198-1216.
11. Frederick II and the Fall of the Hohenstauffen.

III. THE FORMATION OF FRANCE, TO 1328.

12. The Rise of the Capetian Dynasty, to 1180.
13. France under Philip Augustus and St. Louis, 1180-1270.
14. Philip the Fair of France, 1285-1314, and Pope Boniface VIII, 1294-1303.

IV. THE EAST AND THE CRUSADES, 1096-1270.

15. The East before the Crusades.
16. The First Crusade, 1096-1099.
17. The Kingdom of Jerusalem and the Second Crusade.
18. The Third and Fourth Crusades.
19. The End of the Crusades.

V. CHRISTIAN AND FEUDAL CIVILIZATIONS.

20. The Church in the Thirteenth Century.
21. Mediæval Schools and Universities.
22. The Life of the Military Classes.
23. Peasant Life.
24. Towns and Town Life.
25. Mediæval Commerce.

VI. THE ERA OF THE RENAISSANCE, FOURTEENTH AND FIFTEENTH CENTURIES.

26. Germany and the Empire, 1273-1493.
27. France in the Fourteenth and Fifteenth Centuries; The Hundred Years' War.
28. The Consolidation of Spain into a Powerful Monarchy.
29. Political and Social Conditions in Italy in the Fourteenth and Fifteenth Centuries.
30. The Beginning of the Renaissance in Italy; The Revival of Learning.
31. The Fine Arts during the Renaissance.
32. The Age of Great Discoveries and Inventions.
33. Reforming movements of the Fifteenth Century.

VII. THE PROTESTANT REVOLUTION AND THE WARS OF RELIGION, 1517-1648.

34. The Eve of the Reformation in Germany.
35. The Lutheran Reformation, to 1525.
36. Charles V and the Reformation in Germany, 1526-1555.

37. The Zwinglian Reformation in Switzerland, to 1531.
38. John Calvin and his Work.
39. Rise of Protestantism in France, to 1572.
40. France under Henry IV.
41. The Catholic Reformation and the Jesuits.
42. The Revolt of the Netherlands, 1568-1648.
43. The Thirty Years' War, 1618-1648.

VIII. THE ASCENDANCY OF FRANCE AND THE AGE OF
LOUIS XIV.

44. Richelieu and the Establishment of the Absolute Monarchy.
45. Louis XIV (1661-1715) and his Court.
46. The People; Colbert and his Reforms.
47. Louis XIV's Wars.

IX. THE AGE OF FREDERICK THE GREAT.

48. The Formation of the Russian Empire, Peter the Great.
49. The Expansion of Russia in the Eighteenth Century.
50. The Beginnings of the Prussian State. 1640-1740.
51. Frederick the Great, 1740-1786.
52. Frederick the Great in Time of Peace.
53. The Expansion of England.

X. THE FRENCH REVOLUTION.

54. The Struggle for the Succession, 44-31 B. C.
55. Growth of a Revolutionary Spirit before 1789.
56. Louis XVI (1774-1793) and Attempts at Reform.
57. The Beginning of the Revolution, and the Destruction of the Old Regime, 1789.
58. The Attempt to Make a Constitution, 1789-1791.
59. The Failure of the Constitution and Fall of the Monarchy, 1791-1792.
60. The First French Republic and the War against Europe, 1792-1793.
61. The Reign of Terror, 1793-1794.

XI. NAPOLEON BONAPARTE, 1795-1815.

62. France in 1795.
63. General Bonaparte in Italy and Egypt, 1796-1799.
64. Bonaparte as Consul, 1799-1804.
65. The Napoleonic Empire, 1804.
66. Napoleon's Campaigns from Austerlitz to Tilsit, 1805-1807.
67. The National Uprisings against Napoleon, 1808-1812.
68. The Downfall of Napoleon, 1813-1815.

XII. GROWTH OF NATIONALITY, DEMOCRACY AND LIBERTY IN THE NINETEENTH CENTURY.

69. The Congress of Vienna and Metternich's System of Absolution.
70. The Paris Revolutions of 1830 and 1848.
71. France under Napoleon III and the Third Republic.
72. The Unification of Italy.
73. The Struggle for Liberty and Unity in Germany, 1815-1858.
74. The Foundation of the German Empire under Bismarck and William I (1858-1888).
75. Austria-Hungary under Francis Joseph I, 1848.
76. Turkey and the Eastern Question.
77. Development of Russia in the Nineteenth Century.
78. The Expansion of Europe.
79. The Material Progress of the Nineteenth Century.

ENGLISH HISTORY.

I. EARLY BRITAIN.

1. The Land and its Resources.
2. Britain before the Roman Conquest.
3. Britain and the Romans, 55 B. C. to 410 A. D.

II. THE BEGINNINGS OF ENGLAND, FIFTH TO TENTH CENTURY.

4. The Coming of the Angles and Saxons
5. The English Kingdoms.

6. England and the Danes, Eighth and Ninth Centuries.
7. Reunion of England Under Wessex, Tenth Century.

III. ENGLAND UNDER FOREIGN RULE, ELEVENTH AND
TWELFTH CENTURIES.

8. The Danish Conquest, 984-1042.
9. The English Restoration, 1042-1066.
10. England and the Normans, 1066-1154.
11. The Early Angevins, 1154-1199.

IV. THE STRUGGLE FOR CONSTITUTIONAL LIBERTY, THIR-
TEENTH CENTURY.

12. Winning the Charter.
13. The Shaping of the Nation.
14. The Struggle for Good Government.
15. Progress under Edward I.
16. "The British Idea."

V. THE HUNDRED YEARS' WAR, 1327-1453.

17. Edward III and France, 1327-1377.
18. The Social Revolt of the Fourteenth Century.
19. The Constitutional Monarchy, 1309-1461.
20. The House of Lancaster and France, 1414-1453.
21. The Wars of the Roses, 1455-1485.

VI. ENGLAND UNDER THE TUDORS, 1485-1603.

22. The New Monarchy.
23. The Renaissance in England.
24. The Beginnings of the English Reformation.
25. The Age of Elizabeth, 1558-1603.
26. Tudor England.

VII. THE PURITAN REVOLUTION, 1603-1660.

27. The Beginning of Strife, 1603-1625.
28. Breach between King and Parliament 1625-1629.

29. The Personal Rule of Charles I, 1629-1640.
30. The Long Parliament.
31. The Great Rebellion, 1642-1649.
32. Puritan Rule, 1649-1660.

VIII. RESTORATION AND REVOLUTION, 1660-1688.

33. England under Charles II, 1660-1685.
34. Overthrow of the Stuarts, 1688.

IX. WARS OF EMPIRE, 1689-1815.

35. William III and Louis XIV, 1689-1697.
36. The War of the Spanish Succession, 1702-1713.
37. The War of the Austrian Succession, 1740-1748.
38. The Seven Years' War, 1756-1763.
39. The American Revolution, 1775-1783.
40. The War of the French Revolution, 1793-1802.
41. War against Napoleon, 1803-1815.

X. HANOVERIAN ENGLAND.

42. The Constitution after the Revolution of 1688.
43. Religion and Philanthropy.
44. The Industrial Revolution.

XI. THE UNITED KINGDOM IN THE NINETEENTH CENTURY.

45. The Rise of Democracy.
46. The Life of the People.
47. Relations of England and Ireland, 1800-1900.

XII. THE BRITISH EMPIRE.

48. India and the Eastern Question.
49. The Colonies.

ADVANCED AMERICAN HISTORY.

The law provides,—chapter 96, Laws of 1901, section 4, as amended by laws of 1903 and 1905,—that an approved high school shall include reasonable instruction in the con-

stitution of the United States and in the constitution of New Hampshire. The department will approve instruction according to the scope of the following outline as such reasonable instruction, the same to be required of every pupil. The teacher should follow in full the History Syllabus for Secondary Schools.

I. DISCOVERY AND EXPLORATIONS PRIOR TO 1607.

1. The Land and its Resources.
2. Discovery of America.
3. Exploration and Early Settlements, before Jamestown, 1492-1607.

II. SOUTHERN COLONIES, 1607-1660.

4. Virginia, a Typical Southern Colony.
5. Maryland.
6. Carolinas and Georgia, the Southern Frontier Colonies.

III. NEW ENGLAND, 1620-1760.

7. Beginnings of Colonization of New England. Character and Aims of Puritans, Pilgrims, and Plymouth Colony.
8. Early Massachusetts.
9. New England, 1636-1760.

IV. MIDDLE COLONIES, 1609-1760.

10. Dutch and English in New York.
11. Pennsylvania, "A Quaker Experiment in Government," New Jersey and Delaware.

V. COLONIES IN EIGHTEENTH CENTURY TO 1760.

12. Political, Social, and Economic Development of the Colonies, 1700-1750.
13. Struggle between France and England for North America, 1689-1763.

14. Condition of the Colonies in 1760 (or 1765), Political, Social, and Economic; Comparisons between the Three Sections.

VI. UNION AND INDEPENDENCE, 1760-1783.

15. Causes of the American Revolution, 1760-1783.
16. The Revolution, 1775-1783.

VII. THE CRITICAL PERIOD, 1783-1789.

17. Confederation and Constitution.

VIII. THE FEDERALIST SUPREMACY, 1789-1801.

18. Organization of the National Government.
19. Foreign Relations, 1793-1800.
20. Fall of the Federalists, 1798-1801.

IX. THE JEFFERSONIAN REPUBLICANS, 1801-1817.

21. General Principles and Domestic Policy of Jefferson's Administration.
22. Expansion.
23. Struggle for Neutral Rights.

X. REORGANIZATION, 1817-1829.

24. Economic Reorganization.
25. Westward Migration and Internal Improvements.
26. Slavery and the Missouri Compromise.
27. The Monroe Doctrine and the Panama Congress.
28. Political Reorganization and the Triumph of Jackson.

XI. NATIONAL DEMOCRACY, 1829-1844.

29. Nullification in South Carolina; the Question of State Sovereignty.
30. Financial Question, 1830-1842.
31. Anti-Slavery Agitation, 1831-1838.

XII. SLAVERY IN THE TERRITORIES, 1844-1860.

32. Annexation of Texas and the Mexican War.
33. Struggle over Slavery in the Territories.

XIII. SECESSION AND CIVIL WAR, 1861-1865.

34. Secession of the Southern States.
35. The Civil War.

XIV. PROBLEMS OF PEACE, 1865-1904.

36. Reconstruction, the New South, and the Race Problems.
37. Political Problems Since 1865.
38. Economic Problems Since 1865.
39. Summary and Review of American History.

In addition to the above outline, and toward the close of the work, there must be a thorough review of the constitution and a thorough study of the constitution and government of New Hampshire as a typical commonwealth, the whole constituting a review and synthesis of the civil government of nation, state and municipality. The study of American history, and of English history if taken, is a prolonged study of civil government, and needs for its completion only the crystalizing effect of a concise, but thorough-going civil government summary.

HISTORY OF COMMERCE.

See Chapter XIII, Commerce.

CHAPTER VIII.

MATHEMATICS.

ELEMENTARY ALGEBRA.

1. Algebra to quadratics.

The fundamental operations; factoring, including the finding of highest common factor and lowest common multiple, and roots; fractions, including complex fractions; ratio and proportion; simple equations, both numerical and literal, containing one or more unknown quantities, with applications; radicals, including the extraction of the square root of polynomial algebraic expressions and of numbers expressed arithmetically; exponents, both fractional and negative.

2. Quadratics and radicals.

Quadratic equations, both numerical and literal; simple cases of equations with one or more unknown quantities which can be solved by the methods of simple or quadratic equations, including radical equations; problems involving quadratic equations.

Pupils should be required, in connection with their assigned daily work, to solve numerous problems which involve putting questions into equations. These problems should involve facts and business relating to mensuration, physics and commercial life. Graphical methods and illustrations should be employed in connection with the solution of simple forms of quadratic equations.

PLANE GEOMETRY.

The theorems and constructions of the best text-books, including plane rectilinear figures; the measurement of angles; proportion and similar figures; circles; areas of all kinds; regular polygons and the measurement of circles.

The demonstration of the more important original propositions relating to construction and computation and the solution of problems on loci. Application of principles already learned to the measurement of lines and plane surfaces.

The requirements in original work should be based on some good standard text-book in plane geometry. The demonstration of original propositions should be taken up in connection with the written work of the text-book. A minimum requirement of four hundred original propositions in this course and in the review course should be met in plane geometry. Teachers should strive to give a slight historical sketch of the more interesting theorems or problems to add as much interest as possible to the subject.

The solution of all original propositions should be preserved in carefully prepared note-books. These books should be collected by the teacher at the close of each school year.

Review Algebra.

This is a single-semester course followed by a single-semester course in geometry. After a careful review of principles previously learned, give much attention to the binomial theorem for positive integral exponents, the formulæ for the n -th term and the sum of the n terms of arithmetical and geometric progression with applications. Supplement the text-book with much original work.

Review Geometry.

Single-semester course continuous with review algebra.

The work will be a rapid review of the propositions of the first course and work on original exercises up to the full aggregate specified above.

ADVANCED ARITHMETIC.

Review of elementary arithmetic with advanced applications of principles; the metric system; short processes;

stocks and bonds, exchange, accounts; ratio and proportion; series; mensuration; continued fractions; logarithms and applications.

ADVANCED ALGEBRA.

Permutations and combinations limited to simple cases; complex numbers with graphical representations of sums and differences; determinants, chiefly of second, third, and fourth orders, including the use of minors and the solution of simple equations; binomial theorem; undetermined coefficients; series; logarithms; detached equations; theory of equations; solution of higher numerical equations.

It is expected that the teacher in every department of mathematics will continue to supplement the text-book with original questions for solution.

SOLID GEOMETRY.

The usual theorems and constructions of the best text-books, including the relation of planes and lines in space; the properties and measurements of prisms, cylinders, and cones; the sphere and the spherical triangle; the solution of original exercises, including problems on loci; application to the mensuration of surfaces and solids.

The pupil should preserve the solution of all original work in note-books for future reference. A minimum of one hundred to one hundred and ten originals should be worked out.

PLANE TRIGONOMETRY AND SURVEYING.

The theory of the functions and their relations; circular measurement of angles; proofs of principal formulæ for the computation of the tables and the solution of right and oblique plane triangles, and of problems in surveying, together with the use of surveying instruments; theory and use of logarithms with a thorough understanding of the use of trigonometric tables in the solution of problems.

Surveying may or may not be given in connection with trigonometry. Some schools have instruments and are recommended to place some stress on this course with field work in the same.

CHAPTER IX.

PHYSICS.

The course of instruction should include:

1. Individual laboratory work consisting of not less than forty experiments requiring approximately thirty-five double periods.

2. Instruction by lecture table demonstrations, to be used mainly as a basis for questioning upon the general principles of physics and their applications.

3. The study of one or more standard text-books in order that the student may gain a comprehensive and connected view of the important facts and laws of physics.

Especial attention should be given to the explanation and illustration of the common physical laws and their industrial applications.

This can be accomplished through:

(a) Lectures and prepared explanatory statements by the instructor.

(b) By discussions based upon readings from supplementary scientific books, and articles in papers and magazines, correspondence with or visits to large industrial or manufacturing establishments.

(c) The solution of a considerable number of numerical problems based upon the topics under discussion. *At least one problem should be solved and recorded in the note-book for each experiment performed.*

LABORATORY WORK.

Theory.

The object of preparatory science is not to re-discover old laws, nor to set crude and untrained minds to profitless and aimless experimenting, but rather to verify laws, to

understand their origin, operation and results, and to scientifically observe and systematically record what is noted in these processes.

Therefore a student should have before beginning an experiment: (a) a clear idea of what he is to do; (b) how he is to do it; (c) what results may reasonably be expected; and (d) the principal sources of error. A general idea of the subject gained from text-book and instruction should precede every experiment.

Method.

The ideal method of conducting laboratory work is to have all pupils engaged on the same experiment at the same time. This permits the teacher to instruct the whole section or class upon any point demanding unusual care, or to help backward pupils. It, however, requires so much duplication of apparatus that only well equipped schools can attempt it. Excellent work can be done without the expense of duplicating apparatus by assigning a set of experiments upon one subject.

The number of experiments prepared should be at least equal to the size of the class, working two at one table,—and using the apparatus in rotation. By this plan no two tables are engaged upon the same experiment at the same time. A modification of this method consists of purchasing one each of the more expensive pieces of apparatus and duplicating for individual use those pieces of less expense.

Note-Books.

A record of all observations made by the pupil in performing the experiment should be neatly recorded in a note-book provided for that purpose. This note-book should be the book of original entry, and all record of observations should be made in the laboratory at the time when the experiment was performed and just as indicated by the apparatus used without any change or correction.

Order.

A good order for the arrangement of notes is as follows:

- (a) Date and name of pupil.
- (b) Object of the experiment.
- (c) Record of temperature, pressure, humidity, or any facts having a possible bearing upon the experiment.
- (d) Sketch or description of apparatus used. Drawings should be plain outline diagrams of the apparatus at the most significant part of the experiment, accurate rather than artistic.
- (e) A plain, concise statement expressed in definite and complete sentences describing all the important steps in the experiment. Copying statements from text or manual should not be tolerated.
- (f) A tabular arrangement of all data collected.
- (g) A statement showing the results and how they were obtained.
- (h) A statement of laws derived and general conclusions warranted by the results.
- (i) A statement of the chief causes of error. The total error and the per cent of error.
- (j) The solution and record of at least one problem to illustrate the topic discussed. A great many more experiments should be performed, but not necessarily recorded.

Not all of these subdivisions will occur in every experiment. In general, statements d, e, and f should be recorded upon the left hand pages and all the other items upon the page opposite. Cross section paper with diagrams can be inserted when needed.

Large, unruled note-books ten by twelve inches, or larger, should be used. No records should ever be kept upon scraps of paper or any thing other than the book provided. The original entry may be made with a pencil as it is not always practicable to compel the use of ink in the laboratory. Record on right hand pages can be filled in in ink before the next experiment.

Care.

Much care and neatness should be insisted upon in the keeping of these note-books by the pupils, not only for the disciplinary value, but because these books of original entry are the ones usually required by colleges from all candidates for admission, and should, at least, be legible and clear.

Index.

All note-books should contain an index showing title and number of experiment, also page where recorded.

Certification.

When the note-book has been completed, the instructor should attach the following certificate to the inside of the front cover:

.....High School, N. H.
190....

This note-book contains the original record of the work done by.....
 in the laboratory of the.....
 High School, under my immediate supervision.

The records of experiments on the left hand pages were written in the laboratory at the time when the experiment was performed.

Signed.....
 Teacher of.....

Copies of this certificate can be obtained by application to the Secretary of the College Entrance Examination Board, Sub-station 84, New York City.

Supervision and Correction.

One of the most fatal defects of any system of laboratory work and record, is the lack of supervision and correction of the work done. Careless, inaccurate and slovenly work is often allowed to pass uncorrected, or even unnoticed, and generally for some of the following reasons: (a) lack of

time on the part of the instructor; (b) the inability to secure at a convenient time all of the note-books in which the students are continuously recording their work; and (e) the dislike of correcting an accumulated set of experiments where as much time is often required in finding the experiments as in correcting them. This can be almost entirely prevented by the following plan:

Before *beginning* each new experiment every pupil should be required to hand in to the instructor an abstract or statement of the previous experiment, written in ink, in the following form upon a sheet of paper sixteen inches wide, folded in the middle, and ten inches long, making a four-sheet folder eight by ten, and perforated for binding. The two inside pages are ruled for cross section work. Upon outside of first and fourth pages is the following:

(First Page.)

REPORT SHEET—PHYSICAL LABORATORY.

Name.....
 Experiment No..... Instructor.....Date.....
 Object of Experiment:
 Diagrams of apparatus actually used, and description of
 methods in your own words:

(Fourth Page.)

Conclusions:

Errors and necessary precautions:

The inside pages will contain all readings systematically arranged and an outline of calculations, together with plottings of curves and all necessary section work.

These sheets of proper size and properly printed may be obtained from the college printer at Hanover, N. H. After filling out by the pupil, they are to be handed to the instructor for inspection and correction. When satisfactory, they are to be kept on file by the instructor until the end of the course, when they may be permanently bound and

become the property of the pupil. The Department of Public Instruction requests that such sheets be used and may call for copies for inspection at any time.

EXPERIMENTS.

The following forty experiments approved for the secondary schools of New Hampshire are similar to those outlined by the College Entrance Examination Board, Harvard, The Western Teachers' Physics Association, and other standard schools and colleges.

Inasmuch as explicit directions for performing each of the experiments in this list may be found in nearly every standard text and laboratory manual now published (a list of which is appended), it is not deemed necessary to reprint here all the details of each experiment. Different teachers will adopt different methods for performing the experiments prescribed and are urged to acquaint themselves with the various standard methods now employed. A number of the best and latest laboratory manuals as well as a file of the latest catalogs of all standard makers of physical apparatus should be accessible to the class and new methods, devices and modifications encouraged.

PRELIMINARY EXPERIMENTS.

- A. Measurement of a Straight Line.
- B. Measurement and Computed Area of a Right Triangle and Circle.
- C. Measurement, Area and Volume of a Solid.
- D. Volume of Rectangular Bodies by Displacement of Water.

Note. Directions for performing the above experiments may be found in the Harvard Course pamphlet, Experiment A et seq., also in the National Physics Note-book, Experiment A; the laboratory manuals of Cheston, Dean & Timmerman, page 7; Coleman, page 14; Adams, page 20; Twiss, page 9; Nichols, Smith & Turton, page 2; and

numerous other manuals as well as in the texts of Avery, Gilley, Hoadley, etc.

See also *Scientific American* Supplement No. 200, for "Devices for Measuring," and Supplements Nos. 84, 85, 86 and 87, for "How to Draw a Straight Line." All *Scientific American* Supplements are exceedingly full of valuable information, most of them illustrated and with explicit directions concerning all details. Procurable from Munn & Co., 361 Broadway, New York City, for ten cents each.

Description and use of verniers, calipers, cathetometers, etc., may well be introduced here.

EXPERIMENTS.

HYDROSTATICS AND MECHANICS.

1. Weight of a Unit Volume of a Substance.
2. Lifting Effect of Water upon a Body Entirely Submerged in it and Weight of the Water Displaced.
3. Specific Gravity of a Solid Body that Will Sink in Water.
4. Specific Gravity of a Block of Wood by Means of a Sinker.
5. Specific Gravity by Flotation Method.
6. Specific Gravity of a Liquid. Three methods.
7. Levers. First, Second and Third Class.
8. Center of Gravity and Weight of a Lever.
9. Parallelogram of Forces, two, three, or more.
10. Friction, (a) Solid bodies on a Level.
(b) Coefficient of Friction by sliding or incline.
11. Breaking Strength of Wires.
12. Elasticity of Bending.
13. Compressibility of Air. Boyle's Law.
14. Density of Air.

LIGHT.

15. Use of a Photometer.
16. Images in a Plane Mirror.

17. Images Formed by Concave and Convex, Cylindrical or Spherical Mirrors.
18. Index of Refraction of Glass and Water.
19. Focal Length and Conjugate Foci of a Converging Lens.
20. Shape and Size of a Real Image Formed by a Lens.
21. Color in the Spectrum, or Study of Spectra with a Simple Spectroscope, or Study of Polarized Light.

HEAT.

22. Testing a Mercury Thermometer.
23. Linear Expansion of a Solid.
24. Specific Heat of a Solid.
25. Determination of the Dew Point.
26. Latent Heat of Melting or Vaporization.
27. Conduction of Heat.
28. (a) Increase of Pressure of a Gas Heated at a Constant Volume, or (b) Increase of Volume of a Gas Heated at Constant Pressure.

SOUND.

29. Velocity and Wave Length of Sound.
30. Number of Vibrations of a Tuning Fork.
31. Laws of Vibrations of Strings.
32. Velocity of Sound in Solids. Kundt's Method.

MAGNETISM AND ELECTRICITY.

33. Lines of Force about a Magnet.
34. Study of a Single Fluid Cell. The effect of Amalgamation.
35. Study of a Two-Fluid Galvanic Cell. Constancy. Increase or Loss of Weights of the Elements.
36. Resistance of Wires by Substitution. Various Lengths.
37. Resistance of Wires by Substitution. Cross-section and Multiple Arc.

38. Measurement of Resistance with the Wheatstone Bridge.

39. Temperature Coefficient of Resistance.

40. Battery Resistance. (a) Effect of plate area, (b) effect of varying distance between poles, (c) cells in parallel, (d) cells in series.

The subject of electricity offers an almost unlimited field for the enthusiastic instructor or inventive pupil. The assembling or "setting up" of simple telegraph lines with and without relays, the study of the X-ray, telephone, and the marine cable, construction and operation of small dynamos, motors, wireless telegraph outfits, electric lights, bells, wiring, heating, plating and the manifold applications of electricity to our industrial life render the subject fascinating to the most enthusiastic student. See *Scientific American* Supplement No. 282 for full directions, with illustrations showing how to make a good Holtz Machine; No. 1182, Electric Furnace; No. 761, Electric Motor (small); No. 783, Motor (Gramme Ring); No. 919, Wimshurst Machine; No. 1363, Wireless Telegraph; No. 229, Induction Coil.

APPARATUS.

The following list of apparatus is the minimum amount necessary for a class of twelve, working two at one table, to perform the forty prescribed experiments. With this amount of apparatus, the work must be largely done in rotation as previously described, and the list must be increased if it is to be used by more than twelve pupils. On the other hand, it cannot be diminished much, if it is to be used by less than twelve pupils, since in many cases only one article of a class is called for. Duplicates are necessary, since many experiments, while not identical, require the same pieces of apparatus and it is awkward for groups to be obliged to wait for apparatus.

The list of apparatus is arranged in two columns, A

and B. Articles appearing in column A are necessary, no matter how few or how many are in the class; those in column B are for a standard unit of twelve, and the number may be increased or diminished, as the size of the class requires.

The apparatus required is all standard and can be purchased of any of the firms manufacturing physical apparatus at short notice. Many schools, doubtless, have much of the apparatus already, and will need only to supplement it by reference to this list.

Much of the apparatus is easily made and suggestions towards that end will appear later.

Notes accompanying Experiments and Apparatus are based upon personal experience and are intended to be helpful or suggestive, rather than mandatory.

The list of apparatus is arranged according to the order of the experiments and contains every thing essential for performing them.

APPARATUS.

No.	A.	B.
1.	Meter-rod, with both metric and English graduations.....	6
2.	Thirty cm. ruler, beveled edge.....	6
3.	Ten cm. section of meter-rod.....	6
4.	Waterproofed wooden cylinder 8 cm. long, 4 cm. diameter, loaded internally with shot.....	1
5.	Brass can 14 cm. tall and 7 cm. diam. with overflow tube near the top....	1
6.	Brass catch can with handle, holding about 175 gm. water.....	1
7.	Spring balance of 240 gm. capacity, graduated on one side in 10 gm. divisions, on the other in $\frac{1}{4}$ oz. divisions	1

No.	A.	B.
8. Rectangular block of wood (water-proofed by boiling in paraffin), 8 cm. long, 4 cm. square at each end, loaded internally so that it will sink. Not to exceed 225 gm.....	1	
9. Rectangular block, cherry wood, 8 cm. x 4 cm. x 4 cm. Not loaded.....	1	
10. One-gallon glass jar.....		4
11. Wooden rod 30 cm. long, 1 cm. square, loaded	1	
12. Copper sulphate or salt.....	2 lbs.	
13. Hydrometer jar about 35 cm. tall, 8 cm. diam.....	2	
14. Specific gravity bottle, glass stoppered. 200 gm. capacity.....	1	
15. Assorted glass tubing one meter long	1 lb.	
16. Three-way glass tubes, small.....		3
17. Hydrometer for liquids heavier and lighter than water.....	1	
18. Harvard Trip Scale with iron weights 1 kilo to 5 gms.....	1	
19. Thirty cm. sections of meter-rod pivoted at the center by a screw to bar of hard wood about 25 cm. x 5 cm. x 3 cm.....		3
20. Scale pans for No. 19.....		4
21. Spring balances, 10 kgm. capacity....	3	
22. Flat pine board, 3 ft. long, 1 ft. wide, 1 inch thick.....	1	
23. Pine block, 8 x 4 x 2 inches.....	1	
24. Small single wooden or brass pulley..		3
25. Spring brass wire No. 27, B. & S. gauge	1 spool	
26. Cylindrical graduate 250 cu. cm.....	2	
27. Pine rods, 102 cm. x 1.3 cm. x 1.3 cm..	2	
28. Pine rods, 102 cm. x 2.6 cm. x 1.3 cm.		6

No.	A.	B.
29.	Micrometer screw caliper with electric connections	1
30.	Hard wood prisms, 3 cm. long and 2 cm. wide.	4
31.	Set of iron weights, 100, 200, 300, 500, and 1,000 gms.	1
32.	Barometer	1
33.	Mercury	2 lbs.
34.	Glass tube for Boyle's law, or Boyle's law apparatus	1
35.	Two-litre glass bottle.	1
36.	Perforated rubber stopper to fit No. 35	1
37.	Rubber tubing, thick wall, .5 cm. int. diam.	10 ft.
38.	Rubber tubing, ordinary, .5 cm. int. diam.	10 ft.
39.	Pinchcocks	4
40.	Air pump for exhaustion and compression, or aspirator.	1
41.	Set of brass weights, 500 gm. to 1 gm.	1
42.	Bunsen photometer.	1
43.	Wax candles	12
44.	Plane mirror, 6 x 2 inches.	2
45.	Concave and convex cylindrical mirror	1
46.	Concave and convex spherical mirror.	1
47.	Piece of plate glass, 7 cm. square, 6 cm. thick, opposite sides ground and polished	1
48.	Gilley refraction board (easily made).	1
49.	Set of demonstration lenses, three convex, three concave.	1
50.	Lens holder, pins, and card holder, set for use on a meter stick.	3 sets
51.	Small kerosene lamp with perforated asbestos or metal shield.	1
52.	Glass prism	1

No.	A.	B.
53. Apparatus A.....		2
54. Thermometer, glass etched, F. and C. scale		4
55. Copper alcohol lamps.....		6
Note. If gas is available, this is, of course, preferable.		
56. Linear expansion apparatus. The best kind is provided with a micrometer screw at one end and movable pointers at the other.....	1	
57. Brass rod to fit No. 56.....	1	
58. Aluminum rod to fit No. 56.....	1	
59. Dry air tube with globule of mercury.	1	
60. Calorimeter		4
61. Lead shot	2 lbs.	
62. Hydrometer, Mason's.....	1	
63. Steam trap for vaporization experiment	1	
64. Set of wires for conduction in heat experiment	1	
65. Tuning fork, 256 vibrations.....	1	
66. Apparatus for determining the number of vibrations of a tuning fork.....	1	
67. Sonometer	1	
68. Small vise	1	
69. Glass tube about 75 cm. long and about 2.5 cm. diameter.....	1	
70. Bar magnet	2	
71. Horseshoe magnet	1	
72. Compass, small.....		3
73. Photographic plates, 5 in. x 7 in. rapid.		6
74. Skidmore Battery outfits		3
75. Galvanoscope	1	
76. Daniell cell, small		3
77. Sulphuric acid.....	1	
78. Galvanometer, tangent	1	
79. Galvanometer, D'Arsouval type.....	1	

No.	A.	B.
80. Commutator		2
81. No. 30, German silver wire.....	1 spool	
82. Double binding screws		1 doz.
83. No. 28 German silver wire	1 spool	
84. Astatic galvanometer	1	
85. Wheatstone bridge, slide wire pattern	1	
86. Set of resistance coils on spools.....	1	
87. Resistance box	1	
88. Temperature coil.....	1	
89. Wire gauge, B. & S.....	1	
90. Brass divider with needle point, pen and pencil, 5 in.....	1	
91. Brass protractor, 5 in.....	1	
92. Micrometer, caliper	1	
93. Vernier caliper	1	
94. Glass U tube, arms one meter long....	1	

MANUFACTURE OF APPARATUS.

The making of simple pieces of apparatus by members of the class should be encouraged in every school where practicable. By this practice a rare interest in the subject is maintained, a large amount of apparatus which must otherwise be done without is obtained at a comparative slight cost, a spirit of self-reliance and investigation fostered and minds dormant or mischievous often aroused to activity and usefulness.

Select a pupil or group of pupils naturally inclined to tools and their use, assign some piece of interesting and simple apparatus, provide explicit directions, raw material and a little enthusiasm, and the pupils will do the rest.

Some of the articles best adapted for home manufacture, are the following. They have all been made by pupils of preparatory schools in the state, are fully described in accessible books, supplements and manuals, and are a great addition to the equipment of any laboratory.

1. Jolly Balance.

2. Coefficient of Friction Apparatus.
3. Dynamo.
4. Half Horse Power Motor.
5. Wireless Telegraph.
6. Seconds Pendulum with Electric Contact and Bell.
7. Induction Coil, one inch spark.
8. Wimshurst Machine, six inch spark.
9. Telegraph Set.
10. Set of Levers and Pulleys.
11. Inclined Plane.
12. Wheel and Axle.
13. Refraction of Light Apparatus.
14. Trolley Car.
15. Numerous Blocks, Prisms, Cylinders, etc., of wood.
16. Acetylene Light Apparatus.
17. Atwood's Machine.
18. Electric Lights, Arc and Incandescent Systems.
19. Bell Wiring.
20. Barometer.
21. Thermometer and numerous other articles.

Every laboratory should be equipped with a suitable supply of the common carpenter's tools, a good work bench, and supply of hard and soft woods planed on both sides. This will enable broken apparatus to be repaired, and encourage the production of new.

Every laboratory should be provided with a suitable sink and table for every two pupils. Also a good supply of running water, and gas if possible. If not, the next best means of obtaining a supply of heat suitable for all physical and chemical experiments is the gasolene torch or blast lamp similar to that used by plumbers. Of course, a suitable number of brass or copper alcohol lamps should be provided, and racks or standards for supporting articles provided for the tables.

Book cases for the science library and reference books should be in the laboratory, pictures of scientists or scien-

tific inventions adorn its walls, and the whole atmosphere of the place made attractive, instead of the dismal, bleak effect of attic or cellar corners and closets, too often assigned for laboratory work.

The following list of books should form a part of every school library, together with others previously mentioned:

<i>Author.</i>	<i>Title.</i>	<i>Publishers.</i>
Daniel,	A Text-book of Physics,	MacMillan.
Everett,	C. C. S. System of Units, with Tables of Physical Constants,	MacMillan.
Edser,	Heat for Advanced Students,	MacMillan.
Ganot (Atkinson),	Physics,	Longmans, (Also Wm. Wood & Company).
Hopkins, G. H.,	Experimental Science,	Munn & Co.
Jackson & Jackson,	Elementary Electricity and Magnetism,	MacMillan.
Maxwell,	Theory of Heat (re- vised by Lord Rayleigh),	Longmans.
Thompson, S. P.,	Elementary Lessons in Electricity and Magnetism,	MacMillan.
Thompson, S. P.,	Light, Visible and In- visible,	MacMillan.
Watson,	Elementary Practical Physics,	Longmans.
Tyndall,	Lectures on Light,	Harper & Bros.
Tyndall,	Lectures on Sound,	Harper & Bros.

CHAPTER X.

CHEMISTRY.

(See also Physics).

The course of instruction in Chemistry should include:

1. Individual laboratory work consisting of exercises requiring about thirty periods, in which at least fifty experiments should be performed and recorded.

2. Instruction by lecture table demonstrations to be used as a basis for questioning upon the general principles of chemistry and their applications.

3. The study of at least one standard text-book in order that the pupil may obtain a comprehensive and connected view of the more important facts and laws of elementary chemistry.

4. The mathematical solution of numerous chemical problems, work which is valuable not only for crystallizing and defining chemical knowledge, but also as a review and application of the principles of arithmetic.

It is recommended that throughout the course especial attention be paid to the common illustrations of chemical phenomena and their industrial, physiological and hygienic applications; that visits be made to chemical works, dye shops, gas plants, and the like where possible; that papers and periodicals devoted to the subject be regularly taken for class use; that special reference books and various texts, manuals, catalogues, and the like be kept constantly and easily accessible to the pupils; and that the laboratory be made as attractive and workable as possible.

LABORATORY WORK.

Theory.

The chief aims in a preparatory course in chemistry are: (1) to train the student's mind and faculties by teaching

him to observe accurately; (2) to draw correct conclusions from the observations; and (3) to furnish some first hand information about well known materials, their manufacture, properties and use. Therefore no attempt should be made to gain a comprehensive knowledge of the facts of the science, nor in any way to encroach upon the province of collegiate instruction, but rather to appeal to the experiment instead of the text for answers to questions, and to stimulate the reasoning powers of the pupil by constant questioning, supervision and correction.

Method, Note-books, etc.

The remarks under physics upon these subjects should be observed so far as possible in chemistry.

Since the apparatus and materials necessary for performing the experiments in chemistry are for the most part simple and inexpensive, the individual method should be followed much more largely than is usually possible in physics.

Two students working at the same table may profitably perform the same experiment together.

Blanks similar to those described under physics should be filled out and handed to the instructor before beginning a new set of experiments. Note-books should be indexed, and when completed, the instructor should insert the following certificate, copies of which may be obtained by application to the Secretary of the College Entrance Examination Board.

I certify that this note-book is a true and original record of the experiments actually performed by.....

.....in the chemical laboratory of

.....school during the year.....

.....

Instructor in Chemistry.

EXPERIMENTS.

All experiments should illustrate some fact under discussion, and should be continuous and cumulative, where

possible, rather than isolated. It is far better for an instructor and his class to learn a considerable number of related facts from a simple set of experiments rather than to discover almost nothing from a single spectacular exhibition. Therefore the following list of experiments, recommended by the College Entrance Examination Board is approved for the preparatory schools of New Hampshire. Select 50, including six quantitative.

LIST OF EXPERIMENTS.

1. Composition of the atmosphere.
2. Dissociation of mercuric oxide and study of the resulting products.
3. Burning of magnesium, sodium, and potassium in air, and of iron in oxygen, with study of resulting products.
4. Combination of substances produced in (3) with water, and study the results.
5. Burning of sulphur and phosphorous in the air; study of products.
6. Combination of substances produced in (5) with water; study of products.
7. Treatment of substances resulting from (3) and (4) with hydrochloric acid, and examination of final products.

Laws of Gas Volumes and Vapor Tension:

8. Boyle's Law.
9. Charles's Law.
10. Vapor tension as related to temperature.

Common Elements and Compounds:

11. Preparation and study of oxygen.
12. Weight of a litre of oxygen under standard conditions.
13. Preparation of hydrogen by action of sodium on water. Careful study of by-product.

14. Preparation of hydrogen by zinc and acid. More thorough study of hydrogen in larger quantities. Study of by-product.
15. Weight of a litre of hydrogen under standard conditions. (Optional for best students.)
16. Proportion by volume in which hydrogen and oxygen unite. (Lecture demonstrations with eudiometer.)
17. Proportion by weight in which hydrogen and oxygen combine.
18. Study of boiling point, freezing point, action on litmus, and taste of substance produced by combining oxygen and hydrogen.
19. Electrolysis of water, resulting gases being accurately measured and tested.
20. Vapor density of water, conclusions as to formulæ for water. (Optional for best pupils.)
21. Study of sodium, potassium, lithium, strontium, calcium, and barium compounds. Detection of presence of these metals by flame test of spectroscope.
22. Study of salts of cobalt, copper, nickel, manganese, chromium, iron. Tests for these metals and those mentioned in 21, in unknown mixtures.
23. Study of compounds of aluminum, magnesium, and zinc. Tests for these in mixtures of 21 and 22.
24. Tests for silver, lead, and bismuth in unknown mixtures of 21, 22 and 23.
25. Tests for mercury and arsenic in unknown mixtures of 21, 22, 23 and 24.
26. Preparation and study of chlorine gas.
27. Weight of a litre of chlorine.
28. Combustion of chlorine in hydrogen
29. Preparation of hydrochloric acid and study of properties.
30. Decomposition of hydrochloric acid gas by sodium amalgam, and conclusion as to percentage. Avogadro's law.

31. Preparation and study of at least three chlorides.
32. Preparation and study of bromine.
33. Preparation of at least three bromides.
34. Preparation and study of iodine.
35. Preparation of at least three iodides.
36. Comparative study of the chemism of chlorine, bromine, and iodine by mutual displacement.
37. Study of hydrofluoric acid and fluorides.
38. Determination of the combining proportions of chlorine and zinc and the atomic weight of zinc.
39. Atomic weight of zinc from specific heat, law of Dulong and Petit.
40. Atomic weight of silver by displacement of zinc.
41. Study of forms of sulphur.
42. Direct formation of sulphides.
43. Study of sulphurous oxide.
44. Preparation of sulphurous and sulphuric acids.
45. Preparation of at least two sulphites and two corresponding sulphates. Comparative study of these.
46. Decomposition of ammonium nitrate and study of nitrous oxide.
47. Determination of the composition of nitrous oxide. Gay-Lussac's law.
48. Preparation of three nitrates in three different ways.
49. Composition of gas formed by action of cold dilute nitric acid on copper.
50. Composition of gas formed by union of nitric oxide and oxygen.
51. Preparation of chromic anhydride, chromic acid, and potassium chromate.
52. Changing potassium chromate to potassium bichromate and back again. Oxidation and reduction in solutions.
53. Chromium as an acid-forming and as a base-forming element. Preparation of chromium sulphate.

54. Preparation of ferrous and ferric salts.

Carbon and Some Carbon Compounds:

55. Product of burning charcoal. Tests.
56. Test for presence of carbon in wood, paper, kerosene, coal gas, alcohol.
57. Preparation of three carbonates.
58. Solubility of carbonates in the presence of carbon dioxide.
59. Effect of heat on suspension of carbonates in solution.
60. Carbon dioxide from fermentation.
61. Alcohol from fermentation.
62. Preparation of ether by alcohol and sulphuric acid.
63. Preparation of alkaline salts of fatty acids, or soap making.

EQUIPMENT.

Every laboratory should be provided with water, with gas if possible, and if not, a gasolene blast lamp and sufficient alcohol lamps; a table for every two students, and at least one good well-ventilated hood. Tables should contain lockers, and racks for bottles and apparatus when in use.

Tables can be built by any carpenter, at low cost, which are excellent for performing all the work necessary for physics or chemistry. Iron sinks, arranged tandem, with tables on each side, closets beneath, and shelves on racks above, answer admirably the purpose. In this way one sink serves for four pupils.

The list of apparatus is sufficient for a class of twelve, working two at one table upon the same experiment. The *individual* method is understood to be used except in the experiments requiring more expensive apparatus where the apparatus may then be used in *rotation*.

All articles marked with a star are included in the

physics list and need not be duplicated if that list is owned. Column A contains the number of articles needed, irrespective of the size of the class. Column B is based upon the minimum needs of twelve students. For classes larger or smaller than twelve reduce column B proportionately.

The entire cost of the apparatus exclusive of duplicates, previously provided for in physics, will be about \$60. Add to this about \$25 for the chemicals necessary for one year, and the total, \$85, represents approximately the cost for a minimum outfit in chemistry for a class of twelve. A much larger equipment is desirable, and can be gradually obtained without much expense, by purchasing a few good and necessary pieces of apparatus each year.

No.	Article.	A.	B.
1.	Alcohol lamps		6
2.	Asbestos squares		6
3.	Aspirators		6
4.	Barometer*	1	
5.	Balance*	1	
6.	Balances, hand. with weights*.....		4
7.	Blow pipes, brass.....		6
8.	Burettes		6
9.	Beakers, glass		12
10.	Borer, cork, set.....	1	
11.	Condenser	1	
12.	Corks, assorted		36
13.	Corks, rubber, 2-hole		12
14.	Corks, rubber, 1-hole		12
15.	Crucibles, sand		12
16.	Crucibles, porcelain		12
17.	Clamps, Hoffman		6
18.	Dishes, evaporating, porcelain, 3-in...		6
19.	Droppers, glass		6
20.	Eudiometer	1	
21.	Filter paper, quire 6-in.....		1

No.	Article.	A.	B.
22.	Funnels, 3-in.		6
23.	File, round	1	
24.	File, 3-cornered	1	
25.	Flasks, Erlenmeyer, 4 oz.		6
26.	Flasks, side neck, 4-oz.		6
27.	Forceps, iron.		6
28.	Fruit jars, pint.		12
29.	Glass tubing, assorted.	1 lb.	
30.	Glass cutter	1	
31.	Graduates		6
32.	Hoffman's apparatus	1	
33.	Hygrometer	1	
34.	Ignition tubes.		12
35.	Liter bottle, thin glass for exhaustion. .		6
36.	Mortar, iron.	1	
37.	Mortar, porcelain.		2
38.	Ring stands, 3 rings.		6
39.	Retort glass, stoppered.	1	
40.	Test tubes, 6-in.		144
41.	Test tubes, 8-in.		12
42.	Test tube cleaners.		6
43.	Thermometers, glass.		6
44.	Tubing, rubber, 3-16 in. medium		12 ft.
45.	Test paper, litmus, quire.		1
46.	Tray, lead, 2-in.		6

LECTURE TABLE DEMONSTRATION.

The preliminary lecture work may well be confined to those experiments which are to be done in the laboratory, giving a general description of the method to be used, the object to be attained, and the precautions which must be observed to insure safety and obtain good results.

The later lectures and demonstrations can be used appropriately in amplifying the work done in the laboratory by parallel but different experiments; in explaining more

in detail the principles involved after the class has thought out the main points in regard to them; and in doing any of the experiments for which there is not sufficient time in the laboratory.

Note. A fuller discussion of this subject as well as of *the questions to be asked a pupil and line of thought to be developed by these questions*, may be found in Professor Richards' "Requirements in Chemistry for Harvard," Second Edition, q. v.

Subject-matter for demonstration may be found in almost any advanced chemistry, but care should always be taken to select that which illustrates and teaches, rather than that which only amuses and delights.

REFERENCE BOOKS IN CHEMISTRY.

<i>Author.</i>	<i>Title.</i>	<i>Publisher.</i>
Benedict, Dubbin & Walker,	Chemical Lecture Experiments,	Macmillan.
Hollerman,	Chemical Theory for Beginners, Text-Book of Inorganic Chemis- try,	Macmillan, Wiley.
Lussar-Cohn,	Chemistry of Daily Life,	Lippincot.
Myer, E.,	History of Chemistry,	Macmillan.
Muir,	Heroes of Science. Chemists.	Young & Co.
Newth,	Chemical Lecture Experiments,	Longmans.
Ostwald,	Scientific Foundations of Ana- lytical Chemistry.	Macmillan.
Ostwald.	Manual of Physico-Chemical Measurements,	Macmillan.
Ostwald.	Principles of Inorganic Chemis- try.	Macmillan.
Ramsay,	Experimental Proofs of Chemi- cal Theory for Beginners,	Macmillan.
Ramsay,	Modern Chemistry (Parts I and II),	Macmillan.

<i>Author.</i>	<i>Title.</i>	<i>Publisher.</i>
Smith & Hall,	Teaching of Chemistry and Physics,	Longmans.
Thorpe,	Essays on Historical Chemis- try,	Macmillan.
Thorpe,	Outlines of Industrial Chemis- try,	Macmillan.
Van't Hoff,	Physical Chemistry in the Ser- vice of the Sciences,	University of Chicago Press.
Walker,	Introduction to Physical Chem- istry,	Macmillan.
Hoffmann,	Lectures on Modern Chemis- try, 1865,	
Farrady,	Chemical History of a Candle.	

See also the following Scientific American Supplements for articles upon the following :

- 889. Chemical analysis for beginners.
- 957. Quantitative work for students.
- 290. Manipulation of apparatus. Also 780.
- 493. Wire apparatus for laboratory use. Very valuable.
- 928. Condensation apparatus.
- 962. Chemical laboratories.
- 950. Recreational experiments on the crystallization of sulphate of soda.
- 957. Stereo-Chemistry.
- 112. Thermo-Chemistry.

Also special articles on gas, analysis, spectroscopy, printing, dyeing, coal products, explosives, fireworks, foods, etc.

CHAPTER XI.

BIOLOGY.

It is assumed that most schools will keep biology in the first year continuous with nature study and human physiology in the elementary school and the culmination of the study of animate nature. As such it is an elementary scientific study of animal and vegetable life. It is particularly pointed out that the teacher alone can avoid the mistake of shaping these courses on lines which are collegiate or university rather than secondary; the avoidance rests on his good sense rather than upon any formal shaping of courses.

ZOOLOGY.

Study of animal life based upon text-books with the equivalent of fifty periods in the laboratory.

Each teacher will doubtless prefer to work out his own plan for the course; and circumstances, such as the location of the school and the amount of money available for the purchase of supplies, must largely govern the details of such a plan; but the following scheme is suggested as a convenient, and standard practicable arrangement of topics:

(1) A general survey of the anatomy and physiology of the human body based upon the pupils' previous studies of physiology, and their general knowledge, to review that general knowledge, and serve as a foundation for the study of other animal bodies. In this the teacher should bring out the broad facts concerning the structure and arrangement of the organs of the body, their uses, and the general functions of nutrition, circulation, respiration, locomotion, sensation, etc., which they perform.

(2) The general scheme of classification of the animal

kingdom, embracing the relation of its principal divisions, to give a preliminary bird's-eye view of the whole, and enable the pupils the better to apprehend the places therein of the several forms which they study, when they reach them in turn.

(3) The systematic study of the animal kingdom may then be commenced, beginning with the simplest forms. One or more type forms of each important class should be carefully studied in the laboratory, compared with specimens of allied forms, and supplemented by study of text-books and references. Careful directions should be given by the teacher for all references that are to be looked up in other books. This work will occupy about two-thirds of the entire time assigned to the course. It may be divided as follows:

Protozoa,
Sponges and Cœlenterata,
Echinoderms,
Vermes,
Mollusks,
Arthropods,
Vertebrates.

(4) Generalizations may then be made concerning the nature and relations of animal forms, their life and their habits, under such topics as: the necessary conditions of animal life; the struggle for existence and natural selection; adaptations to environment; the chief lines of advance; parasitism and degeneration; protective resemblances; animal communities; homes and domestic habits; instinct and reason; the geographical distribution of animals; the development of the animal kingdom in time, etc.

(5) Final review and summary in the light of these generalizations; the theory of evolution, and the relation of the human race to the animal kingdom.

The following reference books for zoology are suggested:

Jordan, Heath & Kellogg.....	Animals
Thompson.....	Study of Animal Life
Weed & Crossman..	Laboratory Guide in Zoology
Claus.....	Text-Book in Zoology
Lang.....	Text-Book of Comparative Anatomy
Parker & Haswell.....	Text-Book of Zoology
McMurrich.....	Invertebrate Morphology
Packard.....	Text-Book of Entomology
Comstock.....	Manual for the Study of Insects
Parker.....	Elementary Biology
Hertwig.....	General Principles of Zoology
Colton.....	Descriptive and Practical Zoology
Dodge.....	Elementary Practical Biology
Apgar.....	Birds of the United States

BOTANY.

Study of plant life based upon the text-book with the equivalent of fifty laboratory periods.

The course should include a careful study of the important types of the flowerless, as well as of the flowering plants; and the student should have practice in determining by means of flora and key the species of the flowering and higher flowerless plants. There should be much drawing of specimens, and in the spring and fall, excursions should be made for the study of plants in their natural habitat, and the viewing of such plant societies, and the observation of such varying conditions of growth, with their results, as the locality affords.

The teacher should work out his own plan for the course, or follow that of his text, as in the study of zoology, with due regard to existing circumstances, but the following scheme is suggested as a convenient, practicable and standard arrangement of topics:

(1) Preliminary study of a complete plant of moderate size in flower and one in fruit, to show the parts and or

gans, their arrangement, and their uses, and to bring out the general functions of nutrition, circulation, reproduction, etc., which they perform.

(2) A general study, in order, of stems, roots, leaves; flowers (such as may be available in the fall), fruits, and seeds, to bring out the variety of forms and uses of the several parts of the plant.

(3) A systematic study of the vegetable kingdom, beginning with the simplest forms, and advancing through the several groups. Each group should be introduced by the study of a type form, which should afterwards be compared with allied forms, and supplemented by the study of text-book and references under the careful direction of the teacher.

(4) Generalizations may then be made concerning the nature and relations of plant forms, their life and habits, under such topics as:

The necessary conditions of plant life,
 The struggle for existence and natural selection,
 Adaptions to environment,
 The chief lines of progress,
 Germs and their relation to disease,
 Putrefaction, etc.,
 Vegetable parasites.
 Plant societies,
 Means of protection,
 Fertilization,

and the relations of plants and animals (in connection with this topic may appropriately be made some study of the spring flowers);
 Artificial selection, and the development of new varieties of flowers and fruits;
 The geographical distribution of plants,
 The development of the plant kingdom in time, etc.

(5) Final review and summary in the light of these generalizations, the theory of evolution.

Among the best reference books for the botanical laboratory are the following:

Gray, Manual of Botany and Botanical Text-book	
Bessey	Botany
Clark...Laboratory Manual in Practical Botany	
Setchell	
Laboratory Practice for Beginners in Botany	
Dana.....	How to Know the Wild Flowers
Apgar.....	Trees of the Northern United States
Bergen.....	Elements of Botany
Coulter	Plants
Caldwell.....	Laboratory Manual of Botany

THE BIOLOGICAL LABORATORY.

If possible, a room should be devoted entirely to the purposes of biological study. If the biological classes must share their quarters with those in other subjects, the room should be fitted up for the use of the former, and then other classes should be assigned to it which do not require facilities for laboratory work, such as classes in the languages, which can recite in the room without interfering in any way with the disposition of biological material. The room should be well lighted, and should be provided with running water and, if possible, with gas taps to which Bunsen burners can be affixed. Instead of the usual school desks and seats fastened to the floor, there should be movable individual tables and chairs, which can be arranged as convenience may require.

The tables should have flat tops, two by three feet in dimensions, which, for greater ease in keeping clean, should be covered with white oilcloth. Each table should be provided with a drawer in which the student may keep his notebook and apparatus. Such tables enable the students to work independently, and without interfering with one another.

There should be a good blackboard and wall racks for

hanging up diagrams. Many diagrams can be easily made by the teacher to supplement the illustrations of the text-book. They may be made with ink and a broad-pointed marking pen upon heavy manila paper, which is best purchased in roll form, thirty-six or forty inches wide, and cut off as needed.

Each student should be provided with a dissecting microscope or a hand lens with a support, and a set of dissecting instruments (scalpel, forceps, scissors and needles), of good quality, also a large oblong shallow pan, lined with wax or paraffin, for dissections.

The laboratory should possess, if possible, a good compound microscope, or still better, a stereopticon with microscope attachment; but neither is indispensable. In case the school owns such equipment, the teacher should be able to prepare slides for the same, a collection of which for illustrative purposes should be gradually accumulated.

So far as possible, the different topics embraced under this study should be taken up in systematic order. But the material needed for illustrations is often not available at those times when it is desirable to study the same. For the purpose of rendering such material available when needed, the teacher should collect supplies when they are to be had, and preserve them for use. Some kinds may be best preserved in alcohol, others by drying, and still other forms may be kept alive in aquaria. The laboratory should have a considerable number of large glass jars for this purpose. Large battery jars are very suitable, or for lack of these, large-sized fruit jars may be used. Full directions for the collection and culture of such material may be found in Weed and Crossman's Laboratory Guide in Zoology.

Each student should be provided with a laboratory notebook with stiff covers and large unruled pages for drawing. To supplement the laboratory work a good text-book should be used. The laboratory should also have at hand for reference such other books relating to the subject of study as can be obtained.

See reference lists above.

CHAPTER XII.

MECHANIC ARTS.*

The Mechanic Arts curriculum in the high school or academy is the secondary continuation of manual training or sloyd in the elementary school. It does not, however, presume the latter as a preliminary discipline.

Manual training as carried on in the elementary school is purely pedagogical. That is, it proposes to educate through the training of the hand and its fundamental importance in the whole psycho-physical life of the child. It does not propose to train for a special purpose in life, nor does it contemplate any differentiation among normal children. Manual training in the elementary school is as important for the child who is to become a professional man, or a housekeeper, as for one whose destiny is the trades.

Mechanic arts in the secondary school is all that manual training is and much more.

(1) It proposes to continue the use of hand work for its value in producing mental accuracy and thoroughness.

(2) It proposes to reveal to the boy of mechanical bent his own powers and aptitudes, and to *educate* him in the direction of industrial pursuits rather than in the direction of commercial life or a profession. In other words, it proposes to make of him an educated carpenter, or plumber, or machinist, rather than to educate him for the law, or medicine, or commerce, and leave him unprepared for his mechanical vocation. It expects to make of him to some extent, a cultivated man, and at the same time, to give him a good foundation for his calling.

* For the several courses in Mechanic Arts, acknowledgment of helpful service is made especially to the following:

Mechanic Arts High School, Boston, Mass.

St. Paul Mechanic Arts High School, St. Paul, Minn.

The California School of Mechanic Arts, San Francisco, Cal.

Menomonie Public and Stout Manual Training School, Menomonie, Wis.

(3) While the curriculum has first in view the boy who is unable to go further than the high school, it will also provide an excellent preparation for higher scientific and technical schools.

(4) The mechanic arts curriculum contemplates an addition to the wealth of the state and nation of a more highly educated generation of artificers.

Because of its comparatively unfamiliar subject-matter, this chapter is made somewhat more detailed than it otherwise would be.

DRAWING.

FIRST COURSE.

Concrete Descriptive and Plane Geometry: Projections of single solids, three or more views in third angle. Revolution on various axes. Cutting planes and sections.

Practical geometric problems,—tangents, polygons.

Developments and Patterns: Problems of single solids.

Shapes of sections, elbows, etc.

Constructive Design: Application of principles of design in studies of wood carving.

Building Construction: Framing details of wooden house construction, detail of first floor, second floor, attic floor and roof.

Machine Details: Working drawings of tools, or builder's hardware.

Expression: Use of instruments, inking, lettering.

Parallel Course in Representative Drawing: Studies of familiar and beautiful objects, groups, house sketches, studies of historic architecture and ornament, characteristics of Egyptian, Assyrian and Greek styles.

SECOND COURSE.

Concrete Descriptive and Plane Geometry: Projections of intersecting right solids, views in third angle. Revolu-

tion on axes. Planes and sections. Practical geometric problems. Applications to building construction, arches, windows, and decoration of surface. Applications to machine design, ellipse, oval, helix, and spiral.

Developments and Patterns: Problems of warped and special surfaces.

Constructive Design: Application of principles of design in studies for goblets, balustrades, vase forms, etc. Studies for wrought iron design, grilles, gates, andirons, fire sets, etc.

Building Construction: Details of wooden, brick, or stone house construction. Doors, windows, foundations and chimneys.

Machine Details: Bolts, nuts, and screw threads. Pulleys.

Expression: Line shading. Conventions. Tinting. Isometric representation.

Parallel Course in Representative Drawing: Studies of familiar and beautiful objects. Groups. Home sketches. Drawing from casts. Perspective problems, furniture, interiors, etc. Studies of historic architecture and ornament. Characteristics of Roman, Byzantine, and Saracenic styles.

THIRD COURSE.

Concrete Descriptive and Plane Geometry: Projections of single and intersecting right solids in third and first angle. Projection of shadows. Practical geometric problems. Applications to machine design; cycloid, epicycloid, hypocycloid, and involute.

Developments and Patterns: Problems of surfaces and the making of patterns to fit special conditions.

Constructive Design: Application of principles of design in studies for castings, panels, reliefs, fire-backs, etc.

Building Construction: Plans and elevations of a two-story wooden dwelling-house.

Machine Details: Gearing. Cranks. Eccentrics. Cams.

Selected details of machines; lathes, upright engine, dynamo, etc.

Expression: Tracing. Blue-prints.

Parallel Course in Representative Drawing: Studies of groups. Home sketches. Drawing from casts. Memory and imaginative drawing. Perspective problems. Studies of historic architecture and ornament. Characteristics of Romanesque, Gothic, Renaissance and modern styles.

FOURTH COURSE.

Concrete Descriptive and Plane Geometry: Projections of single and intersecting solids, both right and oblique, in third and first angles. Projections of shadows. Advanced geometric problems.

Developments and Patterns: Special problems in surface development.

Constructive Design: Application of principles of design in studies for relief, in stone or terra-cotta.

Building Construction: Plumbing and drainage details. Heating and lighting problems.

Machine Details: Complete details and assembly drawings from measurements from a lathe, upright drill, sharper, upright engine, dynamo, etc.

Expression: Tracings. Blue-prints. Filing, labeling, and checking systems.

Parallel Course in Representative Drawing: Advanced study. Groups, still life. Advanced cast drawing. Perspective problems. Studies of historic architecture and ornament. The Renaissance. Comparison of historic styles.

CARPENTRY AND WOOD-CARVING.

1. Measuring and lining exercises.

- (a) On a rough board with a two-foot rule and pencil; chalk line, try-square and pencil; bevel and pencil.

- (b) On a smooth piece with a marking guage; try-square and knife; and with bevel and knife.
 - (c) On a smooth piece with compasses, straight edge and knife; making a protractor with 15 degree divisions.
2. Sawing exercises, preparation of stock for models.
- (a) Rip and cross-cut sawing to pencil lines; rough board resting horizontally on trestles.
 - (b) Rip sawing in adze lines, pieces held upright in vise.
 - (c) Buck sawing, square ends and sides of grooves, the pieces resting on bench hooks.
 - (d) Sawing kerbs in mitre box.
 - (e) Curve sawing with hand turning saw and power jig-saw.

3. Sharpening exercises.

- (a) Straight and curved edge tools on grind-stone.
- (b) Sharpening or beveling 6 x 2 x $\frac{1}{8}$ inch, white holly on prepared sandpaper block.
- (c) Whetting straight and curved edge tools on oil stones.

Applications: plane-iron, chisel, gauge, carving tools, cabinet scraper.

4. Planing exercises.

- (a) Making plane surfaces. Jointing edges and planing to gauge lines.
- (b) Block-planing square ends with pieces held in vise.
- (c) Oblique edge and end planing.
- (d) Rabbeting, beading, molding.

Applications: square prism, octagonal prism, hexagonal prism, winding sticks, picture frames, typical joints.

5. Nailing Exercises.

- (a) Nailing square joints, using cut and wire nails.
- (b) Toe nailing.
- (c) Nailing mitre joints.

Applications: nail box, screw box, bracket, picture frame, splice joint.

6. Boring Exercises.

- (a) Perpendicular boring with augur bits across the grain entirely through.
- (b) Perpendicular boring to a given depth, both across and with the grain.
- (c) Boring with awls, drills and countersinks.

7. Chiseling Exercises.

- (a) Sides and bottoms of grooves across and in the direction of the grain.
- (b) Oblique surfaces.
- (c) Inside of boxes.
- (d) Curved surfaces.

Applications: sliding gauge, mortice and tenons, dove-tail, oil stone box, glove box, octagonal tooth handles.

8. Glueing Exercises.

- (a) Rubbed joints.
- (b) Clamped joints.
- (c) Doweled and keyed joints.

Applications: winding sticks, T squares, drawing boards, picture frames, hopper joints.

9. Form work.

- (a) Plotting curves from straight lines on plane surface free-hand.
- (b) Plotting curves on curved surfaces.

Applications: coat hanger, bread trencher, hammer handle, octagonal tool-handles.

10. Wood-carving exercises.

- (a) Flat and oblique surfaces cut with firmer and skew chisels.
- (b) Beads and rosettes cut with firmer and skew chisels.

- (c) Cutting straight and curved lines with veining and parting tool.
- (d) Fluting and beading with gouges.
- (e) Geometric designs cut in low relief on flat surfaces.

Conventional designs cut in high relief on both plane and curved surfaces.

Applications: pencil tray, book rack, picture frames, stamp box, jewel case, music rack, flower-pot stands.

11. Elementary pattern-making.

- (a) Description and use of simple moulder's flask.
- (b) Names and uses of moulder's tools.
- (c) Characteristics of patterns; shrinkage, draft, and finish.
- (d) Finishing of patterns.

Applications: awning hinge, angle and machine wrench, double-end S wrench, straight and bevel boat chocks, cleat, oiler, shelf, boat hook, parts of machines.

WOOD-TURNING AND PATTERN-MAKING.

I. WOOD-TURNING.

Each of the four exercises illustrates a fundamental operation. The useful models, begun as applications of the first exercise, are finished as applications of subsequent exercises.

Exercises.

1. Cylindrical and plane surfaces.
2. Conical surfaces.
3. Convex curved surfaces.
4. Concave curved surfaces.

Applications: turning between centres, file handles, carving mallet, chalk line reel, and awl handle, stocking ball, and needle box.

Chuck turning, napkin ring, powder box, goblet.

Supplementary work.

Bench stops, tool handles, mallets, rolling pin, oil-spoon handle, glove ball, gavel, dumb bells, Indian clubs, candle stick, stool, towel rings, boxes, match safe, napkin rings, cups and goblets, spheres, vase forms, mirror frame.

II. PATTERN-MAKING.

Quarter bend pipe and core box, and pulley: hanger and hanger yoke; or hollow chuck and core box, and stand for lathe rest and core box.

Supplementary work.

Gear blanks, paper weight, blank for taper socket, collars, face plate, hanger box, screw chuck, tool rest, hand wheel, eccentric, eccentric strap, block for turning eccentric, loose pulley for sensitive drill.

FORGING.

Continuous practice in forging difficult machine parts, such as engine shafts, connecting rods, and other parts; accessories for hoists, cranes, etc.; forge tools, lathe tools, carriage and wagon parts, etc. Also, structural and ornamental ironwork, and sundry selected jobs covering the entire field of forging.

1. Description and operation of forge and care of fire.
2. Names, characteristics, and use of tools.
3. Typical processes: drawing, shouldering, forming, bending, upsetting, twisting, scarfing, welding, punching, hardening, tempering.
4. Sources and properties of materials: common iron, Norway iron, Bessemer steel, open-hearth steel and crucible steel.
5. Applications: butt ring, hook and staple, bolt, nut, timber hanger, bracket, eye bolt and ring, chain, and hook, tongs, centre punch, cold chisel, cape chisel, spring, lathe tools, square reamer.

Supplementary instruction.

- Estimates, contracts, and specifications.
- Properties, sources, and prices of materials used.
- Metallurgy of iron; production of steel; manufacture of rolled steel shapes, and their uses.
- Saturday excursions to ironworking establishments.

MACHINE-SHOP PRACTICE.

Machine-shop practice in all its details requiring work at the vise and including use of lathe, planer, shaper, milling machine, drill press, etc.

1. Chipping and filing of plane surfaces, cast iron.
 - (a) Use of measuring and marking tools.
 - (b) Chipping narrow surfaces with flat chisel.
 - (c) Chipping broad surfaces with cape and flat chisels.
 - (d) Filing flat surfaces and testing straight edge.
2. Drilling cast iron finished model.
 - (a) Accurate location of holes.
 - (b) Form and action of flat drill.
3. Filing and fitting: a sliding fit—cast iron.
 - (a) Filing plane surfaces at rough angles, testing with try-square.
 - (b) Production of parallel surfaces, testing with calipers.
 - (c) Fitting piece to slide in groove of fixed dimensions.
 - (d) Chamfering.
 - (e) Draw-fitting and polishing, with an emery cloth.

4. Filing and fitting: a dove-tailed fit—wrought iron.
 - (a) Filing blanks to required dimensions.
 - (b) Roughing mortise by drilling and hack-sawing.
 - (c) Fitting parts to drive together.
5. Ring bolt and square head bolt—wrought iron.
 - (a) Tapping nuts.
 - (b) Threading nuts, adjustable and solid dies.
6. Machinist's clamp—machinery steel.
 - (a) Filing, drilling, and tapping steel.
 - (b) Hand turning in steel.
 - (c) Threading with die at the lathe.
7. Surface plate—cast iron, brass handles.
 - (a) Planing, roughing and smoothing cuts.
 - (b) Drilling and tapping.
 - (c) Hand turning in brass.
 - (d) Use of die.
 - (e) Scraping.
8. Paper weight—composition metal.
 - (a) Use of hand turret and slide rest.
 - (b) Hand turning.
 - (c) Polishing and lacquering.
9. A set of lathe tools—shaping faces that form a cutting edge.
10. Perfect cylinder—cast iron.
 - (a) Centering.
 - (b) True live centre.
 - (c) Alignment of dead centre; geometrical relation of the axis of revolution to the tool path.
 - (d) Squaring ends.
 - (e) Turning: use of automatic feed.
11. Nut mandrel—machinery steel.
 - (a) Turning and finishing steel.
 - (b) Screw-cutting in the lathe.

12. Finished hexagon head bolt and nut—wrought iron.
 - (a) Facing a nut.
 - (b) Turning, ream fit.
 - (c) Screw cutting, stopping the thread.
 - (d) Milling nuts.
 - (e) Milling bolt-head with straddle mills.
13. Plate center—cast iron, steel shank.
 - (a) Chucking a hole in a solid casting; use of chuck-drill and reamers.
 - (b) Turning on a mandrel.
 - (c) Taper-turning.
 - (d) Drive fit.
14. Wrist pin—cast iron.
 - (a) Chucking a cored hole: use of chucking and hand-reamers.
 - (b) Turning and fitting mandrel, and use of same.
 - (c) Centering pin at right angles to sleeve.
 - (d) Turning pin with head and shoulder.
15. Hollow chuck—cast iron.
 - (a) Inside threading, finishing with tap in the lathe.
 - (b) Boring and turning on stub mandrel.
 - (c) Finishing with hand tools and polishing.
16. Engine crank, shaft and pin—cast iron and steel.
 - (a) Boring on face plate.
 - (b) Turning shaft—drive fit.
 - (c) Turning pin—shrink fit.
 - (d) Planing key-ways.
 - (e) Fitting key.

Supplementary Exercises. Pins for planer table, with and without screws, lathe centres, machine handles, calipers, hammers, binding-posts, brass ornaments, skate runners, bolts, tool-post screws, sleeves, plain and threaded

collars, and other simple machine parts. These pieces may call also for work upon the planer, shaper, milling machine, or grinding machine.

17. Advanced work.

The models of the latter part of the course, varying considerably from year to year, consist of more difficult single pieces, small tools, and simple machines, or portions of machines, including closely related parts which one pupil makes and assembles. Examples: drill sockets, gears, mandrels, reamers, counterbores, taps, milling cutters, eccentric and straps, parts of a hand lathe, engine, dynamo, drill press, or other machine.

EQUIPMENT.

The equipment of a school with machines, tools, and materials sufficient to give satisfactory courses in Mechanic Arts will naturally vary with the location of the school, its size, special purpose, and the money at its disposal.

Every school, however, should be provided with plenty of raw material, including lumber dressed and undressed, hard and soft, sawed in suitable dimensions; iron, steel, sand; tools for carpentry, woodworking, moulding, forging, machinery necessary for machine shop practice in wood and metal; work benches, draughting tables, forges and some suitable source of power, preferably electric.

COST.

The expense of equipping a Mechanic Arts curriculum seems considerable when compared with other curricula, since it requires not only the books, laboratories and supplies of the academic school, but a large amount of extra machinery and special tools.

The expense is materially lessened if, as will usually be the case, the classes of the technical curriculum can be combined with those of the academic department, and use the same books, laboratories, and supplies.

If a school has a fund or appropriation sufficient for its needs, it is perhaps advisable to purchase all its equipment at one time, otherwise the burden may be very materially relieved by purchasing a smaller number of good machines and tools at first, and then requiring others to be made by the pupils later. In this way excellent speed and power lathes, dynamos, motors, engines and tools of all description have been obtained at a cost barely exceeding that of the raw material.

The expense can still further be reduced by requiring each pupil to pay a fixed charge each term covering the cost of raw material used, and to provide himself at his own expense with drawing instruments and other tools which he uses constantly, and which will be useful to him after his school course is finished.

The expense to the pupil would thus be about as follows:

Raw material (per year).....	\$5.00 to \$10.00
Set of woodworking tools.....	2.75
Drawing instruments.....	5.00 to 7.50
Note-book for woodwork.....	.35
Apron and blouse.....	.60

Good work benches with two vises and a small number of tools suitable for wood work can be obtained for about \$12 each.

The following suggested outfits can be obtained for the price listed at almost any first-class house carrying this line of tools. As the price of screw cutting lathes, power drills, milling machines, planes, and the like equipment, varies greatly according to the kind and amount of attachments provided, no attempt will be made to outline the exact cost nor to indicate the machines best suited for the work. Each competent instructor will naturally have his preferences, which, if based upon experience and good judgment, should generally be consulted before securing the more expensive part of the machine working equipment.

In general it may be said that a good screw cutting lathe, such as the Star, Reed or Barnes, suitable for manual training work, will cost from one hundred dollars to two hundred dollars, according to size. Seventy-five dollars should purchase the necessary chucks, drills, dogs and turning tools. Milling machines with attachments cost from three hundred dollars up. Planers, five hundred dollars and up. Upright drills, seventy-five dollars.

CARPENTRY OUTFIT.

- 1 Bench 42 in. x 32 in. x 20 in. with two vises and stops,
- 1 Hammond nail hammer,
- 1 Stanley block plane,
- 1 Buck Bros. chisel $\frac{1}{4}$ in. handled and sharpened,
- 1 Buck Bros. chisel $\frac{1}{2}$ in. handled and sharpened,
- 1 Buck saw 10 in.,
- 1 Jenning's dowel bit, $\frac{3}{8}$ in.,
- 1 Gimlet bit, 3-16 in.,
- 1 Barber nickled bit brace, 8 in.,
- 1 Try square,
- 1 Buck marking gauge,
- 1 Screw driver, 4 in.,
- 1 Knurled nail set,
- 1 Round hickory mallet,
- 1 Box wood rule, 24 in.,
- 1 India oil stone,
- 1 Sloyd knife,
- 1 Maple bench hook,
- 1 Bench duster.

Price, \$13.

BENCH MACHINIST'S OUTFIT.

- 1 Bull dog vise,
- 1 Machinists' pein hammer,
- 1 Sawyer's combination square and centre head, 9 in.,

- 1 Starrett's hack saw frame and blade,
- 1 Pair B. & S. spring dividers, 4 in.,
- 1 Pair B. & S. outside calipers, 6 in.,
- 1 Pair B. & S. inside calipers, 4 in.,
- 1 Steel rule, 6 in.,
- 1 Marking awl,
- 1 Knurled prick punch,
- 1 Knurled centre punch, $\frac{3}{8}$ in.,
- 1 Cold chisel, $\frac{5}{8}$ in.,
- 1 Cape chisel, $\frac{1}{2}$ in.,
- 1 Handled flat bastard file, 10 in.,
- 1 Half round second cut file, 10 in.,
- 1 Hand second cut file, 10 in.,
- 1 Half round smooth file, 10 in.,
- 1 Round second cut file, 6 in.

Price, \$10.

BLACKSMITH'S OUTFIT.

- 1 Champion agricultural lever forge,
- 1 Hay-Budden anvil, 70 lb.,
- 1 Fire set,
- 1 Pair straight lipped tongs,
- 1 Pair pick-up tongs,
- 1 Hardy to fit anvil,
- 1 Bottom fuller, $\frac{5}{8}$ in.,
- 1 Bottom swedge, $\frac{3}{4}$ in.,
- 1 Flatter, handled, 2 in.,
- 1 Top fuller, handled, $\frac{5}{8}$ in.,
- 1 Swedge, handled, $\frac{3}{4}$ in.,
- 1 Plumb engineer's hammer,
- 1 Ball pein machinist's hammer,
- 1 Handled flat bastard file, 10 in.,
- 1 Boxwood rule, 24 in.

Price, \$20.

WOOD TURNER'S OUTFIT.

- 1 Crown hand speed lathe with countershaft, chuck, cup,
and spur centres,

- 1 Buck Bros. handled and sharpened turning chisel, $\frac{1}{4}$ in.,
 - 1 Buck Bros. handled and sharpened turning chisel, $\frac{1}{2}$ in.,
 - 1 Buck Bros. handled and sharpened turning chisel, $\frac{3}{4}$ in.,
 - 1 Buck Bros. handled and sharpened turning gauge, $\frac{1}{4}$ in.,
 - 1 Buck Bros. handled and sharpened turning gauge, $\frac{1}{2}$ in.,
 - 1 Buck Bros. handled parting tool, $\frac{3}{4}$ in.,
 - 1 Boxwood rule, 24 in.,
 - 1 Handled cabinet file, 10 in.,
 - 1 Winged caliper, 8 in.
- Price, \$62.

DRAUGHTING OUTFIT.

- 1 Set drawing instruments, 8 pieces, boxed,
 - 1 Drawing board, 26 in. x 20 in.,
 - 1 T square, adjustable head, 26 in.,
 - 1 Set triangles, 12 in.,
 - 1 Triangular scale, 12 in.,
 - 1 Flat scale, 12 in.,
 - 1 Protractor, 5 in.,
 - 1 Box thumb tacks,
 - 1 Bottle India ink.
- Cost, \$9.

CHAPTER XIII.

AGRICULTURE.

It is coming to be a generally recognized principle in education that those great activities through which the *race has been enlightened* can well be depended upon as a means of *educating the individual*, whenever they can be organized for that purpose. Among these activities are agriculture, commerce, the mechanic arts, and various fundamental industries such as the textile arts and the arts of the household.

A curriculum in agriculture for the secondary school contemplates the following purposes:

(1) It proposes to utilize the science of agriculture as a means of general culture, parallel for this purpose with physics, chemistry, and the languages.

(2) It proposes to meet the boy whose previous interests have been those of the farm on the ground of those interests, and interpret them to him as a worthy part of higher education.

(3) It proposes to offer to him a sound educational basis for an efficient and worthy life as a husbandman.

(4) While primarily for the boy who cannot go to college, it also will serve as an excellent preparation for advanced schools of agriculture.

(5) It contemplates an addition to the wealth of the state and nation in a more highly trained generation of farmers.

So far as the courses of this curriculum are identical with those of other curricula, they will be found at the appropriate place above,—for instance, botany, physics, modern languages. It is assumed that the school will usually combine courses in this curriculum with those in other curricula. Wherever this is unnecessary, on

account of a large equipment and faculty, it is suggested that the school authorities will usually find it convenient and profitable to give biology, physics, chemistry and book-keeping somewhat special application to agricultural uses.

AGRICULTURE.

1. Soils, fertilizers and drainage.

Classification of soils. Relation of soils to water. Soil temperature. Plant food in the soil. Plowing, harrowing, rolling, planting. Soil fertility as affected by farm operations. Biological properties of soil. Chemical properties of soils. Farm manures. Source and use of commercial fertilizers. Object and effect of drainage. Kinds, location and size of drains.

2. Farm crops.

Relation of crops. Crops as affected by climate. Classification of farm crops: Wheat, corn, oats, barley and rye; grasses and clovers; silage and forage crops; root crops; sugar plants; fiber crops; miscellaneous crops. History, varieties, structure, harvesting and uses. Weeds, dissemination and eradication.

Texts and references:

- “First Book of Farming,” by Goodrich.....
Doubleday, Page & Co.
 “Three Volumes on Agriculture,” by Brooks....
King-Richardson Co.
 “Soils and Crops of the Farm,” by Hunt & Mor-
 rowOrange Judd Co.

COMPARATIVE PHYSIOLOGY.

The general structure of the human body, based on the work in vertebrate zoology. The physiology of the skeleton, and movement, digestion, respiration, circulation. Sources, transformation and use of energy in the body.

The hygiene of the various organs. Comparison of the skeleton, digestive system, and their physiology, etc., with those of the domestic animals.

Text-books:

For the class room, Martin's Human Body, last edition, or an equivalent.

For the laboratory (the time may well be divided equally between class room and laboratory),

Brown, Physiology for the Laboratory.

Peabody, Laboratory Exercises in Physiology.

HORTICULTURE.

The class may select any one of the following subjects (1) Fruit growing (Pomology), (2) Flower growing (Floriculture), or (3) Vegetable growing (Olericulture).

The following books are recommended for text:

- (1) "Lessons in Fruit Growing".....Goff
- (2) "Home Floriculture".....Rexford
- (3) "Vegetable Gardening".....Green

The course in Botany of the freshman year must precede these courses.

RURAL ENGINEERING.

1. Construction of farm buildings.

Best sites for buildings. Horse and cattle barns. Sheep barns and piggeries. Silos. Poultry houses. Creameries and ice houses. Root cellars and granaries. Dwelling houses. Size and material. Arrangement of rooms. Windows and porches. General arrangement of buildings with regard to drainage and prevailing winds. Plans and drainage with specifications and estimates of cost of different buildings.

2. Road making and farm mechanics.

Essentials of a good road. Grades. Solidity. Smoothness. Impervious to water. Farm roads. Country roads,

width, convexity, ditches, waterbreaks, and bridges. Care of roads. Improvement of country roads. Materials for road building. Dirt, gravel, macadam and Telford roads. Farm engines and motors, steam, gasoline, windmills and tread powers. Principles of draft, size and speed of pulleys. Lacing belts and splicing ropes. Purpose, use and comparison of farm machines.

Texts and references:

- “ Barn Plans and Outbuildings ”.....
By Orange Judd Co.
 “ The Farmstead,” by Roberts...Macmillan Co.
 “ Good Roads Magazine ”.....New York

RURAL ECONOMY AND FARM MANAGEMENT.

The farm as a source of income. Value of farm as affected by surroundings and by its own natural qualities. Value of improvements. Rents, leases and tenantry. Rural law, property, deeds, mortgages and titles, trespass and water rights, highways and roadsides; legal fences. Accounts and invoices. Cost and relative profits of different systems of management. Number, size, shape and arrangement of fields. Fences and fencing material. Water supply and sewage. Household administration, economy and comfort. A study of agricultural statistics from census reports.

Text: “ The Farmer’s Business Handbook,” by Macmillan Co.

ANIMAL HUSBANDRY.

1. Breeds of farm animals.

The origin, history, characteristics, adaptability and management of the different breeds of horses, cattle, sheep and swine. A study of the different parts of the animal. Judging animals by the use of score cards. The different

classes and varieties of poultry. Incubators and brooders. The packing and shipping of poultry and eggs.

2. The feeding of animals.

The influence of different kinds of food upon the animal body. Source and preparation of animal feeds. Digestion of food and the changes produced. The study of feeding stuffs and their relative value. Soiling crops. The selection and compounding of rations for the different classes of farm animals.

3. Animal breeding.

A study of the fundamental laws. Heredity and the transmission of normal, abnormal and acquired characters. Inbreeding, close-breeding, line-breeding, cross-breeding and grading. Value of selection and "standards of excellence." The influence of environment. The importance of pedigrees and methods of keeping them.

4. Veterinary elements and diseases.

A study of the physiology and anatomy of the horse and ox. Principles of horseshoeing. The more common diseases of farm animals and methods of prevention. Simple farm medicines, and their modes of application. Care of sick animals.

Texts and references:

- "Animal Breeding," by Shaw. Orange Judd Co.
- "The Study of Breeds," by Shaw.
 Orange Judd Co.
- "Veterinary Elements," by Hopkins.
 Universal Cooperative Co.
- "Diseases of Animals," by McIntosh.
 Donohue & Henneberry
- "Standard of Perfection," by American Poultry
 Association.
- "Farm Poultry," by Watson. Macmillan Co.
- "Feeding of Animals," by Jordan.

EQUIPMENT.

The equipment for the agricultural course need not be extensive in any case. Beyond the regular equipment for physics, chemistry and biology, little need be bought.

In case the school owns a considerable tract of land near the buildings, as sometimes happens, the school should operate it, so far as it can be operated without the purchase of expensive machinery and stock. Competent and energetic business management of the institution which holds some land ought to be able to make the land productive enough to pay the expense of operation and gradually to stock it. Actual outward work is the life and proof of all mental action. The farm itself must be the laboratory of the agricultural school.

In lieu of farm equipment, the instructor must be unwearied in his efforts to keep his students in touch with the actual work of the home farms and those of neighbors. In many instances the student may utilize a part of the home farm for working out his school problems.

The latter should be real and concrete rather than abstract and formal.

The instructor is particularly urged to keep closely in touch with the State College at Durham, and with the Agricultural Department at Washington.

CHAPTER XIV.

COMMERCE.

See also introduction to chapters on Mechanic Arts and on Agriculture.

An insight to the organization and forces of the modern commercial world is not a less factor in an education which proposes to place the individual in efficient relations with his present environment than any other part of the whole program of studies, or, to put the statement in another form, such an insight is not less a means of true education than is a curriculum of letters to others or a curriculum of science to others still.

The commercial curriculum proposes:

(1) To meet boys and girls on the ground of their past experiences, environment and interests, and to educate them in part through a discipline germane to those interests. It does not propose to turn out efficient bookkeepers, and disclaims all intentions to do so. Special vocational training must come after school in the counting-room itself. The school undertakes to lay the foundation therefor in an educated youth whose awakened capacities are in that direction.

(2) While the curriculum has primarily in view those who must earn their living after the end of secondary education, it expects to prepare for those collegiate institutions which offer commercial studies in the course for the bachelor's degree.

(3) Sound education through commerce and into commercial life must add to the forces of the nation a generation whose outlook upon commerce is increasingly broader, saner, and away from mere commercialism.

It is assumed that the courses not covered in this chapter will usually be combined with the same courses in

other curricula. Whenever the faculty of a school is sufficient, it is suggested that English, foreign language, physics and chemistry can profitably be given a somewhat special bearing in sections composed entirely of commercial students.

BOOKKEEPING.

The legitimate purpose of the courses in bookkeeping and business practice in the secondary school is to teach the pupil a competent understanding of the general principles of accounts, to give him some insight into the orderly ways of business transactions, and to develop in him habits of neatness and powers of accuracy. No secondary school should pretend to turn out accomplished bookkeepers; that may come only in higher institutions or more often after apprenticeship in the counting room.

By business practice is meant the buying and selling of representative merchandise by the pupils. Business practice bears the same relation to bookkeeping which the laboratory bears to that of physics, and no course in bookkeeping not based on business practice can be approved for secondary schools. The best treatises on bookkeeping include the business practice.

The instructor will ordinarily follow the plans laid down in an approved textbook. The following outline is, however, added to indicate the proper standard for this course in the secondary school.

ELEMENTARY.—FIRST COURSE.

Study of elementary business transactions and the relations of the parties thereto.

Drills in preparing business papers and forms and in interpreting the business transactions which produce them.

Business correspondence throughout. This phase of the work can be given special force and interest if the correspondence is actually with other schools.

Record of business transactions from the business pa-

pers received and issued, with special attention to the preparation of balance sheets and statements, ledger closing, analysis of accounts, etc.

Books of account should include cashbook, sales book, journal, ledger and trial balance book.

Incidentally, many of the principles of commercial law can be applied and explained in connection with the discussion of the various transactions, especially those bearing upon notes, acceptances, indorsements, etc.

ADVANCED.—SECOND COURSE.

The advanced course will include applications of book-keeping and accounting to wholesale, retail, jobbing, commission, manufacturing and other kinds of business conducted as partnerships, joint stock companies, or corporations, with all the various books of account and rulings found in general use in the various special lines suggested.

COMMERCIAL GEOGRAPHY.

Commercial geography in the secondary school in its relations to the geography of the elementary school must be conceived in much the same way as commercial arithmetic in its relation to the earlier arithmetic. It will be a review but at the same time an advance toward a particular view point in the domain of geography. It ought to prepare young people to become more efficient business men and women, but its main purpose must be understood to be the educated business man rather than the man trained for immediate commercial productivity. The vocational aim sinks to the minimum, the broadly educational aim rises to the maximum.

The legitimate objects of the course may be summarized as follows:

I. A study of the nations of the earth in their commercial relations, that is to say, their natural resources and limitations; their products, both natural and manufac-

tured; the natural trade rivals of each; and their commercial and industrial organization, including especially the relation of education to prosperity in each.

II. A more exhaustive study of the United States from the same standpoints, including especially the relations of the industries and changing trade relations of the nation.

III. An intensive commercial study of New Hampshire and New England as a typical trade and industrial area.

Commercial geography is one of the subjects which it is especially difficult and perhaps impossible to teach well from the text-book alone. The following essential aids to study are named:

(1) A working set of specimens of the principal commercial staples and products, in sizes and form suited to handling in class: This should be kept up to date.

(2) A museum of commercial products, including finer specimens for exhibiting purposes.

(3) Maps, charts, atlases, globes, etc. (Imperative.)

(4) A library of reference books in commerce and in subjects immediately related thereto.

(5) A constant supply of consular reports and other government publications concerning our commercial relations.

(6) Selected theses written by pupils, reserved for use of subsequent classes.

(7) Visits of inspection to stores, factories, etc.

(8) Lectures and talks by local business men.

COMMERCIAL ARITHMETIC.

Commercial arithmetic in the secondary school should not be conceived as merely a review of arithmetic taught in the elementary school. It is that and something more. The essential difference is this: elementary arithmetic covers only the ground which every intelligent person must have covered and which is also essential as preparation for the various mathematical and scientific courses in the

secondary school; commercial arithmetic in the upper school reduces this knowledge to an effective, special tool.

It needs also to be remembered that neither this course, nor any other, can become thoroughly efficient except it be conceived as a process of general mental development as well as a special purpose course.

Attention is especially called to the following passages quoted from the report of the committee of nine to the department of business education, National Education Association:

“ Though business grows steadily more complex, details of organization, and methods of work tend steadily towards simplicity. This tendency results in increased demands for accuracy in fundamental processes and for a working knowledge of the principles of percentage as well as of elementary business principles, with ability to apply them in an increasing number of ways. The study of modern business at close range discloses much that is suggestive to the teacher of commercial arithmetic and that must affect his presentation of the subject. Among these tendencies or conditions which are specially in evidence are the following:

“ 1. The decreasing use of common fractions; those with denominators of two, three, four, six and eight, alone finding extended use. For others, the nearest two-place decimal is the usual substitute;

“ 2. That text-book expressions of quantities in many denominations are not common in actual business. The merchant sells $1\frac{3}{4}$ yds., not 1 yd. 2 ft. 3 in.; the grocer $1\frac{1}{2}$ lbs., not 1 lb. 8 oz.; the engineer measures in feet and hundredths of feet, not in feet, yards and rods;

“ 3. That the majority of business expressions of quantity and value are exceedingly simple, numerically. It follows that ability to work mentally should be cultivated even if the volume of modern business did not demand it. Time and energy should not be wasted on paper calculations, when mental calculation, once a habit, is always easier;

“ 4. That ‘ actual business ’ takes little recognition of text-book case or subject. In a real estate office, a single problem may involve simple percentage, taxes, commission, insurance, interest. Solutions must rest, not on knowledge of arbitrary subjects, but on the bed-rock of fundamental principles;

“ 5. That frequently ability to see as well as solve actual problems is essential. A book says, ‘ I bought 40 chairs at \$8.40, less 15 per cent. discount, paying \$11 20 freight. Terms: 30 days, 2-10. I pay cash. Find the marked price to gain 15 per cent.’ A similar problem was expressed in these words from dealer to clerk: ‘ John, we want to clear 15 per cent. on this invoice,’ handing him a bill. And John noted terms, discount, prices, allowed for freight and for store burden, and marked his chairs.

“ There is this common distinction between the text-book problems and those of actual life: the one class are stated in positive terms, with necessary values and quantities and no unnecessary ones; the second class are frequently not stated, meeting one incidentally in the ordinary course of the day’s work, or are stated only in general terms. Values and quantities must be selected from a mass of values and quantities often concealed in books of record of tabulated forms. In practical arithmetic work, therefore, power of selection must be cultivated:

“ 6. That calculation tables for interest, discount, insurance, taxes, wages, earthwork, etc., are commonly used to save time and insure accuracy. The construction and use of labor-saving tables must thus be understood;

“ 7. That the use of ruled forms, many requiring extensions and calculations for which text-book courses do not prepare, is increasing rapidly. This must be considered in outlining the arithmetic work.

“ The material for the work must be selected at first-hand with such direct aid as an interested class can give. The teacher must consult business men, study the workings of stores and shops, find out the problems which clerks

have actually had, and read current commercial and financial reports. One factory examined from top to bottom, or one trade properly investigated, will yield a wealth of material for class use worth all the set problems in a dozen text-books."

PENMANSHIP.

From the standpoint of vocational education, it may be said that a person who is unable to write a neat, legible, rapid hand is seriously handicapped in any commercial vocation. From the standpoint of general educational values, it may be said that the acquired control over the muscles involved in good handwriting means heightened mental organization, and that, other things being equal, the man who writes a good hand is better educated than he who does not.

After proper training in the elementary school, one period per week for one year is deemed sufficient for formal instruction in penmanship. It should be noted, however, that good handwriting is a habit and that therefore the pupil in commercial courses especially should be required to do his best in every exercise involving handwriting which he submits to any teacher.

STENOGRAPHY.

The teaching of stenography and typewriting in the secondary school must be justified, if at all, on the same ground as handwriting in the elementary school, namely that it is an essential or convenient attainment of everybody in the modern world for the conduct of the ordinary affairs of life. It cannot be justified as a special or professional study for the few, preparatory to a special occupation, and that alone.

No method or system is prescribed.

At the end of the second year students must be able to write accurately in shorthand from dictation 500 words in

five minutes and transcribe the notes either in long hand or with the typewriter in forty-five minutes.

OFFICE WORK FOR STENOGRAPHERS.

This will include instruction in the routine work of the office amanuensis, such work as manifolding with carbon, mimeograph and neostyle, filing letters, etc., copying letters—with press, roller, and carbon. It is expected that the school will be able to furnish either through its own offices or by other arrangements, practice in actual office work for its students.

TYPEWRITING.

See also stenography.

No system of instruction is prescribed.

The course in typewriting will be carried on simultaneously and in connection with stenography. At the end of the second course the student should be able to write on the typewriter ordinary matter at the rate of fifty words a minute for three minutes, and to copy unfamiliar printed matter at the rate of thirty-five words per minute for three minutes.

HISTORY OF COMMERCE.

A brief survey of broad features of the world's commercial development. As such, a secondary course in this subject will deal with (1) the primary elements of the commercial strength of each of the great trading nations, (2) effect of great movements or institutions like the crusades or feudalism on commercial development, (3) interaction of commerce and political organization, (4) the development of the industrial order from its primitive beginnings, (5) the origin, development and influence of transportation, (6) a study of the modern industrial and commercial world.

This course is made a semester course followed by a

semester of political economy, of which it is the pedagogical foundation. It is pointed out that bright students intending to elect these courses should be encouraged to elect the second year history from another curriculum, if offered.

The course cannot properly be given without extensive use of collateral reading of manifold description, charts and other similar aids.

POLITICAL ECONOMY.

The consensus of opinion seems to be that political economy as a distinct course has no place in the curricula long established in the secondary school. That it has essential place in a thorough-going commercial curriculum there can be little doubt.

For this course, for which one semester is deemed sufficient, a modern treatise will be provided and the instructor will, of course, follow in the main the lines laid down in his text. The following points should be noted:

I. That this course will be in a large measure an organization of knowledge acquired in other courses, both elementary and secondary, notably geography, history, civics, and business practice.

II. That it is therefore desirable that the principles taught should stand out with great clarity before the pupil's mind, unencumbered with a mass of illustrative detail.

III. That nevertheless each principle taught should be focalized and clinched by illustrative praxis.

IV. That under no circumstances should the course be allowed to reach out into the domain of unsettled economic principles and especially should it be kept out of present political disagreement and dogmatizing.

The course may properly include an elementary study of such economic terms as wealth, land, rent, capital, interest, labor, wages, etc., as well as the economic princi-

ples underlying, and the economic laws governing the trade of nations, their industrial organization, their currency and banking systems.

COMMERCIAL LAW.

The study of commercial law is important.

(1) As a means to a better understanding of the organization of commerce. Commerce rests, in fact, upon that great body of principles of agreement and confidence between men, known as the law merchant.

(2) As information concerning certain general principles of law which every business man ought to know, and not the less to teach the pupil those limits beyond which the prudent business man should never venture without professional legal advice.

The teacher will ordinarily use a text which will indicate the scope of instruction. The following outline indicates the scope of work which an approved school will cover.

Contracts, bills and notes, agency, partnership, corporations, real property, mortgages, surety and guaranty-ship, bailments, common carrier, fire insurance, landlord and tenant.

The text-book is necessarily the basis of the work, but strict confinement to the text is not likely to produce an understanding of the subject. Most recent texts are supplied with abundant problems in the shape of "cases." If the instructor has no such text, he should collect a supply of such "cases" for class study and praxis.

ADVANCED COMMERCIAL ARITHMETIC.

The advanced arithmetic for the fourth year should be the summing up in mathematical terms of all the technical courses. It should not only sum up what has been taught and give a knowledge also of higher business calculations, but it should correlate the mathematics with all other technical branches of the curriculum and should establish the

rank of arithmetic as an interpreter of business conditions, and of applied arithmetic as a most necessary tool of higher finance. It should call into action all the mind power of pupils strengthened by three years of hard work, mature and trained in the exercise of reason and judgment, and should put before them problems which shall broaden their outlook and help to make them men of affairs.

Such a course may well begin with a review of the earlier field of first year commercial arithmetic. In many cases it may advantageously be combined with the advanced mathematics or review mathematics of other curricula.

The body of the course should follow one of two general lines.

1. It may consist of a study of the mathematical problems of a great business, department by department. For example: the mathematical problems of finance, involving floating of loans, issuing of stocks, etc., necessary for the establishment of a large manufactory; the study of estimates for cost and materials for the manufacturing plant; the mathematical problems of power and other questions relating to the installation of machinery; the problems of the treasurer, in routine business, loans, discounts, pay rolls; a study of cost-keeping, the greatest of all problems in manufacturing; mathematical problems relating to freight rates, shipments, packing; the cost of marketing, advertising, etc.

2. In place of the study of a single great business, great questions common to most kinds of business may be studied in a general way from the mathematical viewpoint. Here single topics suggest themselves, as: advertising, cost-keeping, financing, transportation, annuities, insurance, statistics, general estimates, working tables and their proper design.

In the first case, a new business may be treated each year, and this will have throughout the school a broadening influence of great value. In the second case, illustrations and examples may be drawn from different businesses.

ELEMENTS OF BANKING AND FINANCE.

This course will properly be a continuation of political economy. An adequate study of advanced book-keeping and business practice in the second year will be a useful preparation.

The course should not contemplate a special study of the organization of banking houses, which would properly be a subject for collegiate or other higher institutions. It is more properly a study of the economic principles which underlie the banking and currencies of the commercial world. Its legitimate end and aim is broadly educational rather than special.

The instructor should be able to lay out his own course, keeping it within the comprehension of the pupils with whom he has to deal. The following outline is suggested, as indicating the scope of the work in an accredited secondary school:

The nature and functions of money.

The principles of coinage.

The value of money and influences which modify the same.

The principles and working of exchange.

The currency—metallic and paper.

The origin and principles of banking credit.

Various forms of banks, private, state, national.

Bank-note currency.

The discount system and its meaning to commerce and industry.

The clearing-house system.

Negotiable securities.

At every point in the course where practicable, principles taught must be reduced to mathematical illustration and numerous problems set for solution.

ADVERTISING AND STUDY OF TRADE JOURNALS.

This course will be substantially a course in what may be called technical commercial English.

There are now so many well recognized principles upon which the art of good advertising depends that it may well nigh be called a science. At bottom, advertising is little more than excellent special expository writing, the art of making a possible purchaser understand what you have to sell and of persuading him that he wants it.

The course will be almost entirely a practice course, made up mainly of the writing, criticism, correction, and study of advertisements, circulars, and letters dealing with the sale of goods. The ethics of advertising should form a motive running through the whole.

The study of trade journals will practically be a seminar parallel with advertising, and a continuation of the earlier study of commercial geography and the history of commerce.

Advertising and the study of trade journals cannot be said to have fulfilled its mission in the secondary school unless it shall have been so conceived and taught by the instructor as to yield a better understanding of commerce and thereby a better trained mind. Its purpose must not be supposed to be to produce skilled advertisers capable of earning at once large salaries as such.





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