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BIBLIOGRAPHY OF SCIENCE TEACHING

COMPILED BY A COMMITTEE OF THE AMERICAN FEDERATION OF TEACHERS OF THE MATHEMATICAL AND THE NATURAL SCIENCES

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INTRODUCTION.

The following bibliography of science teaching was prepared by a committee of the American Federation of Teachers of the Mathematical and the Natural Sciences, and edited by Professor Richard Elwood Dodge, Teachers College, Columbia University. The following specialists collaborated in selecting and annotating the titles for the several lists: Biology—Professor Otis W. Caldwell, School of Education, University of Chicago, Chicago, Illinois; Chemistry—New England Association of Chemistry Teachers, and Professor John F. Woodhull, Teachers College, Columbia University, New York City; Geography—Professor Ray H. Whitbeck, University of Wisconsin, Madison, Wisconsin; Mathematics—Professor J. W. A. Young, University of Chicago, Chicago, Illinois, and Professor David Eugene Smith, Teachers College, Columbia University, New York City; Nature study—Professor Maurice A. Bigelow, Teachers College, Columbia University, New York City; Physics—New York Physics Club, and Professor John F. Woodhull, Teachers College, Columbia University, New York City. The necessary limitation in the number of items in each field has doubtless led to the omission of many works of value. It will be found, however, that the titles have been carefully selected, and that items here included are really serious contributions to the field.

BIOLOGY.

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Urges the study of home surroundings and industries, causal relations, the use of maps, globes and pictures. Sufficiently detailed and definite to be really helpful.

11. ———— *chairman.* Report of the committee on secondary school geography. *In* National education association. Proceedings, 1909. [Chicago, Ill., University of Chicago press.] p. 820–28.
Also in Journal of geography, 8:1–9, September 1909.
An analysis of the objection to the type of geography generally taught and a recommendation for the future. The most important report on this subject since that of the Geographical conference of the committee of ten in 1893.

12. **Cook, Jane Perry.** The equipment of a physiographical laboratory. School science and mathematics, 5:421–30, June 1905.
A helpful article with diagrams and cuts showing plans and equipment of such laboratories in Chicago.

13. **Darling, Frank W.,** *and* **Smith, Elizabeth.** The geography course in the Chicago normal school. Journal of geography, 3:55–64, 122–31, February and March 1904.

Outlines in moderate detail the course of study covered in two terms of fourteen weeks each in the normal school. Distinctly a course for prospective teachers.

14. **Davis, William Morris.** Geographical essays. Ed. by **Johnson, Douglas W.** Boston, Ginn and company, 1908. vi, 777 p. 8°.

A collection of over twenty-five essays, published in various periodicals since 1889. Some of the topics are: An inductive study of the content of geography (1905).—The progress of geography in the schools (1902).—The teaching of geography (1892).—The extension of physical geography in elementary teaching (1892).—Geography in the grammar and primary schools (1893).—Physical geography in the high school: The need of geography in the university (1895).—Physical geography as a university study (1894).—Methods and models in geographical teaching (1889).—Field work in physical geography (1902). There is in America no other such valuable collection of geographical essays on the teaching side of the subject.

15. ———— Home geography. Journal of geography, 4:1–5, January 1905.

"I would urge on every teacher the importance of not only leading pupils to observe accessible facts, but of leading them quickly and readily to perceive the meaning of the facts observed."

16. ———— A scheme of geography. Journal of geography, 3:20–31, January 1904.

Also in The geographical journal, 22; 413–23, October 1903.

Presents a device for showing graphically the interrelation among groups of ontographic and physiographic facts.

17. **Dodge, Richard Elwood.** Equipment for geography teaching. Journal of geography, 5:242–50, June 1906.

Contains a rather full list of recommended maps, periodicals, school texts, teachers' books and reference books both for teachers and pupils. Publishers' names are given in each instance.

18. ———— Geography for secondary schools. Journal of geography, 6:241–54, 273–85, March and April 1908.

A summary of nineteen replies to a questionnaire sent to a score or more of geographers and teachers of geography in various parts of the country. These replies constitute a most valuable collection of opinions on the question of what ought to be the character of the secondary school geography work. Should be read by every geography teacher in the secondary school. The replies indicate a marked change in sentiment in recent years.

19. ———— Geography for secondary schools. Journal of geography, 7:121–25, February 1909.

Outline of the round table discussion at the meeting of the Association of American geographers in Baltimore, December 1908. The first formulation of the platform of the movement for humanized geography in the secondary schools.

20. ———— Some suggestions concerning a course of study in geography. Journal of geography, 7:7–14, September 1908.

A clear presentation of the principles which underlie a good course in elementary geography. Emphasizes the greater importance of life geography as compared with physical geography in the elementary school.

21. **Dryer, Charles R.** Geography in the normal schools of the United States. Journal of geography, 4:239–43, May–June 1905.

A report upon the conditions of geography teaching in our normal schools. Facts gathered by a questionnaire and from printed catalogues.

22. ———— What is geography? Journal of geography, 4:348–60, October 1905.

A valuable collection of definitions, opinions and quotations from various American and European sources.

23. **Farnham, Amos W.** The course of study in the Oswego (N. Y.) State normal school. Journal of geography, 5:49–65, 109–19, 211–28, 265–77, February, March, May, and June 1906.

Includes the course in the normal school and also that in the practice school. Detailed and logical and prepared by a man who has had long experience in an excellent school.

24. **Fenneman, N. M.** Problems in the teaching of physical geography in secondary schools. Journal of geography, 7:145–57, March 1909.

Discusses the changes within twenty years in both the subject matter and the method of secondary school geography. Gives suggestions for a course in introductory earth science, discusses laboratory work and advocates regional geography or rational commercial geography.

25. **Genthe, *Mrs.* Martha Krug.** Geographical textbooks and geographical teaching. Journal of geography, 2:227–43, 360–68, May and September 1903.
A scholarly discussion of the fundamental difference in method, in subject matter and in character of textbooks needed by elementary, secondary and mature pupils.

26. ———— Practical exercises to explain the topographic map. Journal of geography, 4:221–26, May–June 1905. Illus.
Helpful in teaching the contour map.

27. **Gibbs, David.** The pedagogy of geography. Pedagogical seminary, 14:39–100, March 1907.
One of our most thorough and scholarly papers on the subject. Deals with: An historical review of geographical textbooks.—An historical review of the methods of teaching geography.—The present status of geography in Europe.—Geography in high schools in the United States.—Geography in our normal schools.—Geography in our technical schools.—Geography in American colleges and universities.—Geography in the elementary schools. Contains a bibliography of ninety-five titles.

28. **Goode, J. Paul.** Commercial geography for secondary schools. Journal of geography, 4:425–32, December 1905.
Also in School science and mathematics, 6:569–77, October 1906.
Outlines the field of commercial geography. States the character of the work which should be undertaken in secondary schools. Discusses illustrative material and the teacher's preparation.

29. ———— The human response to the physical environment. Journal of geography, 3:333–43, September 1904.
Also in Elementary school teacher, 4:271–82, January 1904.
Discusses the gradual decrease in the control over man exerted by his physical surroundings as he advances in civilization. One of the few available papers on this important phase of modern geography.

30. ———— Rapid memory work. New York teachers' monographs, 5:64–70, June 1903.
The psychology and the advantages of memory map work, with specific application to the continents reduced to their lowest terms.

31. **Gulliver, F. P.** Training in geography. Journal of geography, 5:468–73, December 1906.
Urges observational field studies near home and the making of maps.

32. **Hubbard, George D.** College geography. Educational review, 35:381–400, April 1908.
Discusses The nature of the science, The utility of its subject matter, and Courses of construction.

33. ———— Geography in the secondary schools. *In* National education association. Proceedings, 1908. [Chicago, Ill., University of Chicago press.] p. 978–84.
Defends the cultural value of the study and believes that its value in this respect entitles it to more time than it receives in the high school course.

34. **Jefferson, Mark S. W.** Out-of-door work in geography. *In* National education association. Proceedings, 1904. [Chicago, Ill., University of Chicago press.] p. 583–88.
Also in Journal of geography, 4:49–57, February 1905.
Gives reasons why out-of-door work is desirable and discusses existing conditions in secondary school geography.

35. **Jones, Edward D.** Sources of literature for commercial geography. Journal of geography, 1:151–55, April 1902.
Gives list of important governmental publications and of commercial and trade journals, with price and place of publication of the latter.

36. **King, Charles F.** Methods and aids in geography. Boston, Lothrop, Lee and Shepard company, 1907. xvi, 525 p. 12°.
A book dealing with the general principles of geography teaching and with many special problems. Gives special emphasis to the Course of study, What to teach on North America, Commercial geography, Mathematical geography, and includes an extensive list of reference books in two chapters, entitled Sources of information and A list of a thousand books.

37. **Kirchwey, Clara B.** Laboratory work in physical geography in secondary schools. Journal of geography, 4:122–30, March 1905.
Favors laboratory work and gives some details of exercises on isotherms, isobars, winds, rainfall, etc.

38. **McCormick, Henry.** Suggestions on teaching geography. Bloomington, Ill., Public school publishing company, 1899. 169 p. 12°.

A little book of helpful suggestions for young teachers.

39. **McMurry, Charles A.** Excursions and lessons in home geography. New York, The Macmillan company, 1905. ix, 152 p. Illus. 12°.

Chiefly for the third and fourth grades. Contains the subject matter of a large number of "type lessons."

40. ———— Special method in geography. New York, The Macmillan company, 1903. vii, 291 p. 12°.

Outlines a complete course of study from the third through the eighth grade. The plan lays stress on the gradual movement from the home outward, on the strong concentration upon North America and Europe and upon type studies. Contains a graded bibliography.

41. **Marbut, C. F.** Physiography in the university. Journal of geography, 4:23–30, January 1905.

Holds that satisfactory work in the field can be done only when the students map the area studied. Urges the study of models, maps, and photographs. Discusses method of teaching college physiography.

42. **Merrill, J. A.** Physiography in the secondary schools. *In* National education association. Proceedings, 1902. [Chicago, Ill., University of Chicago press.] p. 784–89.

Emphasizes the need of a large proportion of outdoor work.

43. **Mill, Hugh Robert.** Guide to geographical books and appliances. Hints to teachers and students on the choice of geographical books for reference and reading, with classified lists. London, George Philip and son, 1910. viii, 207 p. 8°.

Invaluable reference volume for all teachers. Latest edition is the most complete bibliography of the kind in English.

44. **Redway, Jacques W.** Nature study in the public schools: The geographical phase. *In* National education association. Proceedings, 1900. [Chicago, Ill., University of Chicago press.] p. 411–16.

A plea for elementary observational studies as a part of nature study.

45. ———— The new basis of geography: A manual for the preparation of the teacher. New York, The Macmillan company, 1901. xiv, 229 p. 12°.

Chaps. 7–12 deal especially with the teaching of geography. They treat of The emphasis of essentials, Pictures, models and the globe, Maps and their uses, The course of study, Observation and field work, and The teacher's preparation. Contains a bibliography.

46. **Robinson, Edward Van Dyke.** Economic geography: What it is and what it is not. Publications of the American economic association, 10: April 1909.

Maintains that economic geography is not a part of geography, but a part of economics and can be adequately handled only by an economist.

47. **Salisbury, Rollin D.** The teaching of geography: A Criticism and a suggestion. Educational bimonthly, 3:356–63, June 1909.

Also in Journal of geography, 8: 49–55, November 1909.

Gives questions, with their results, from a test in elementary geography which was given to seventy-five college students in the University of Chicago. Suggests that teachers need to teach more of the useful facts about geography and especially facts of location.

48. **Smith, J. Russell.** Geography in Germany. Journal of geography, 1:420–30, 448–57, November and December 1902.

Describes the geography teaching of the various types of schools in Germany. Gives outlines of courses. Part II deals with university geography in Germany.

49. **Surface, G. T.** Geography in the high school. Journal of geography, 6:348–54, June 1908.

Makes a plea for concrete regional studies and illustrates with a detailed plan for treatment of the Atlantic coastal plain.

50. **Sutherland, William J.** The teaching of geography. Chicago, Scott, Foresman and company, 1909. 292 p. 12°.

A strong and clarifying discussion by an experienced teacher well trained in geography. The analysis of the aims and scope of geography is clean cut. Gives several chapters of practical suggestions for improving the teaching of geography. Contains a bibliography of forty titles of books and papers on the teaching side of the subject, and one hundred and fifty titles on the subject matter side. It is perhaps the best single book for the average teacher.

51. **Whitbeck, Ray H.** The fundamental and the incidental in geography. Journal of geography, 5:66–73, February 1906.

A discussion of those phases of geography which in the writer's opinion deserve emphasis. Believes that some features of the older geography should be retained.

52. ———— Geography in the elementary schools. *In* National education association Proceedings, 1908. [Chicago, Ill., University of Chicago press.] p. 971–77.

Discusses the relative amount of emphasis to be put upon the physical and commercial phases of the study. Urges map study.

53. ———— Practical work in school geography. *In* Eighth international geographic congress. Report, 1904. p. 1025–29.

Discusses modeling, map drawing, the use of outline maps, diagrams, pictures, museum specimens, the taking of field trips, etc.

54. ———— Secondary school geography: What shall it be? School science and mathematics, 7:579–82, October 1907.

Also in Journal of geography, 6:104–7, October 1907.

A plea for the humanizing of our high school course in geography.

55. **Wolfe, Lloyd E.** The human side of geography. *In* National education association. Proceedings, 1903. [Chicago, Ill., University of Chicago press.] p. 143–53.

A reply to Professor Davis' paper read at the Minneapolis meeting of the Society for the scientific study of education. Maintains that a discussion of some of the processes of manufacture and other industries does belong to elementary geography.

During 1904-05 the Journal of geography published a series of articles on Results to be expected from a school course in geography, by the following authors: Farnham, Amos W., 3:424–27, November 1904.—Redway, J. W., 3: 447–50, December 1904.—Emerson, Philip, 3: 450–54, December 1904.—Winslow, I. O., 3:458–62, December 1904.—Tarr, Ralph S., 4:145–48, April 1905.—Whitbeck, Ray H., 4:149–54, April 1905.—Genthe, Martha Krug, 4:155–59, April 1905.—Jefferson, Mark S. W., 4:160–63, April 1905.—Moore, W. C., 5: 320–25, September 1906.

MATHEMATICS.

1. **American mathematical society.** Report of Committee on Definitions of college entrance requirements in mathematics. Educational review, 26: 305–8, October 1903.

Also in American mathematical society bulletin, 10: 74–77, November 1903.

2. **Ammerman, Charles,** *chairman.* Preliminary report of Committee of Central association of science and mathematics teachers on Algebra in the secondary schools. School science and mathematics, 7: 674–85, November 1907.

Also on Geometry.

3. **Bôcher, Maxime.** The fundamental conceptions and methods of mathematics. Bulletin of American mathematical society, 11:115–35, December 1904.

Discusses carefully various definitions of "mathematics."

4. **Branford, Benchara.** A study of mathematical education, including the teaching of arithmetic. Oxford, The Clarendon press, 1908. xii, 392 p. 12°.

A discussion of the history and teaching of arithmetic, algebra and geometry, based on historical and psychological considerations. Contains a bibliography.

5. **British mathematical association.** Committee on Discussion on reform in the teaching of mathematics. Mathematical gazette (London), 2:129–46, January 1902.

6. **Conférences du Musée pédagogique.** L'enseignement des sciences mathématiques et des sciences physiques. Paris, Imprimerie nationale, 1904. xiv, 179 p. 12°.

Consists of the following lectures with discussion: Liard, L., Les sciences dans l'enseignement secondaire.—Poincaré, H., Les définitions générales en mathématiques.—Lippmann, G., Le but des sciences expérimentales dans l'enseignement secondaire.—Poincaré, L., Les méthodes d'enseignement des sciences expérimentales.—Langevin, P., L'esprit de l'enseignement scientifique.—Borel, Émile, Les exercices pratiques de mathématiques dans l'enseignement secondaire.—Marotte, F., L'enseignement des sciences mathématiques et physiques dans l'enseignement secondaire en Allemagne.

7. **Dewey, John.** The psychological and the logical in teaching geometry. Educational review, 25:387–99, April 1903.
   Discusses the extent to which strict logic should dominate the early instruction in mathematics.
8. **Fink, Karl.** A brief history of mathematics. Trans. by **Beman, W. W., *and* Smith, D. E.** Chicago, Open court publishing company, 1903. xii, 333 p. 12°.
   A condensation of Cantor's Geschichte der elementar-mathematik. Covers particularly the history of arithmetic, algebra, geometry and trigonometry, but touches also upon the higher branches.
9. **Jackson, Lambert Lincoln.** The educational significance of sixteenth century arithmetic . . . New York, Teachers college, Columbia university, 1906. 232 p. Illus. 8°. (New York, Teachers college, Columbia university. Contributions to education, no. 8.)
   A full historical discussion accompanied by many suggestions for twentieth century instruction.
10. **Keyser, C. J.** Exercises in thinking about number and space: Transition to algebra and geometry. Educational review, 26:246–53, 394–401, 486–93, October, November, and December 1903; 27:36–41, 160–67, 270–78, January, February, and March 1904.
    A series of "dialog-exercises" developing certain fundamental notions of the subjects named.
11. **Klein, Felix, *and* Reicke, E.** Neue beiträge zur frage des mathematischen und physikalischen unterrichts an den höheren schulen . . . Leipzig und Berlin, B. G. Teubner, 1904. 2 v. in 1. viii, 198 p. 8°.
    Important to the student of the German movement for the improvement of the teaching of mathematics. (Young, J. W. A. The movement for the reform in the teaching of mathematics in Prussia. Bulletin of American mathematical society, 12:347–52, April 1906. Also Science, 23:773–78, May 18, 1906)
12. ———— *and* **Schimmack, Rud.** Der mathematische unterricht. Leipzig, B. G. Teubner, 1907. ix, 236 p. 8°. Teil 1. Von der organisation des mathematischen unterrichts.
    A course of lectures at the University of Göttingen, 1904-05. Discusses the position of mathematics in the various kinds of German schools, also historically contains much of interest to Americans. A strong and modern book.
13. **Laisant, C. A.** Initiation mathématique. Paris, Librairie Hachette et cie., 1906. vii, 167 p. 16°.
    Treats various mathematical recreations and paradoxes not as mere curiosities but from the pedagogic standpoint as introductory to the relevant mathematical topics, ranging from counting to analytic geometry.
14. ———— La mathématique: Philosophie-enseignement. Paris, Georges Carré et C. Naud, 1898. 292 p. 8°.
    Discusses the various branches of mathematics from the elements of arithmetic to analytic geometry, mechanics, and the elements of calculus, first from the standpoint of subject matter, then from that of the classroom.
15. **Lodge, *Sir* Oliver.** Easy mathematics, chiefly arithmetic. London, 1905. xvi, 436 p. 8°.
    An informal discussion of topics of elementary and secondary mathematics that is full of life and suggestions for making the subject interesting.
16. **Loomis, Elisha S.** Original investigation, or how to attack an exercise in geometry. Boston, Ginn and company, 1901. vi, 63 p. 16°.
    Discusses various types of proofs with a view to their use in finding other proofs.
17. **McMurry, Charles A.** Special method in arithmetic. New York, The Macmillan company, 1905. vii, 225 p. 16°.
    Relates chiefly to questions of primary arithmetic.
18. **Moore, Eliakim H.** The cross-section paper as a mathematical instrument. School review, 14:317–38, May 1906.
    A detailed presentation of specific ways in which cross-section paper can be systematically used as a unifying element in mathematics.
19. ———— The foundations of mathematics. Presidential address at annual meeting of American mathematical society, New York, December 29, 1902. Bulletin of American mathematical society, 9:402–24, May 1903.
    Also in Science, 17:401–16, March 13, 1903; School review, 11:321–38, June 1903.
    Discusses the fundamental notions of mathematics and the problems of instruction. Suggests various lines of action looking toward improvement in the teaching of mathematics.

30. **Myers, G. W.** A class of content-problems for high school algebra. School review, 14:563-77, October 1906.

Specific instances of algebraic problems resulting from various loading of beams and the like.

21. ———— Mathematics in the university high school. School review, 14:57-64, January 1906.

Outline of topics of a correlated course for the first two years in a high school. Report on the classroom experiences with the above.—The year's progress in the mathematical work of the university high school. School review, 15:576-93, October 1907.

22. **Newhall, C. W.** A high school mathematics club. Educational review, 29:515-22, May 1905.

Details of organization and program.

23. **Osborn, Clinton S.** Thought values in beginning algebra. School review, 10:169-84, March 1902.

Stenographic reports of actual lessons, with comments.

24. **Packard, John C.** Mathematics and the coördination of mathematics and physics in secondary schools. School review, 11:798-807, December 1903.

A concrete discussion of proposed omissions and additions.

25. **Perry, John, *ed.*** Discussion on the teaching of mathematics which took place on September 14th, at a joint meeting of two sections: Section A.—Mathematics and physics. Section L.—Education . . . to which is now added the Report of the British association committee drawn up by the chairman. Prof. Forsyth. [2d ed.] London, Macmillan and company, limited, 1902, vi, 123 p. 8°.

Opinions of teachers concerning the "Perry movement." Calls for more concrete and practical teaching, for the earlier use of more advanced methods and results.

26. ———— England's neglect of science. London, T. Fisher Unwin, 1900. vii, 113 p. 8°.

The origin of the "Perry movement" for more genuine applied mathematics.

27. **Pringsheim, Albert.** Ueber wert und angeblichen unwert der mathematik . . . München, verlag der K. B. Akademie, in kommission des G. Franz'schen verlags (J. Roth) 1904. 44 p. 8°.

28. **Reidt, F.** Anleitung zum mathematischen unterricht an höheren schulen. Berlin, G. Grote'sche verlagsbuchhandlung, 1886. x, 252 p. 8°.

Covers the elementary and secondary field. Though intended primarily for Germans, the work contains much of general interest.

29. **Smith, David Eugene.** L'enseignement des mathématiques dans les écoles secondaires aux Etats-Unis. Paris, Gauthier-Villars; [etc., etc.] 1908. [269]-284 p. 8°.

"Extrait de l'Enseignement mathématique, no. 4, 10 année, juillet 1908."

Paper read before the Fourth international congress of mathematicians, Rome, April 1908. Explanation of the school systems and the mathematical course in America, with suggestions of reform.

30. ———— The question of problems in elementary mathematics. Educational review, 31:300-5, March 1906.

A summary of the pros and cons of applied and misapplied (merely manipulation) problems and prognostications as to the future trend of usage.

31. ———— The teaching of arithmetic. Teachers college record, 10:1-100, January 1909.

A résumé of some of the more important questions in the teaching of arithmetic, with a discussion of the course of study.

32. ———— The teaching of elementary mathematics. New York, The Macmillan company, 1900. xv, 312 p. 12°.

Discusses the teaching of mathematics in elementary and secondary schools, both from the historical standpoint and from that of present day practice and needs. Full bibliographic references.

33. ———— *and* **McMurry, F. M.** Mathematics in the elementary school. Teachers college record, 4:70, March 1903.

Detailed outline of a course in arithmetic in the various grades.

34. **Stone, Cliff Winfield.** Arithmetical abilities and some factors determining them. New York, Teachers college, Columbia university, 1908. 101 p. 8°. (Columbia university contributions to education. Teachers college series, no. 19.)

A psychologico-statistical investigation of the abilities of sixth year pupils in certain typical schools.

35. **Story, W. E.** The unification of mathematics in the school curriculum. School review, 11:832–55, December 1903.

Calls for the treatment of elementary mathematics as one subject, in a connected, consequent, and progressive way, as an art as well as a science.

36. **Tannery, Jules.** Notions des mathématiques. Paris, Librairie Ch. Delagrave, 1903. x, 370 p. 16°.

A review at the close of the secondary course. Suggestive along the lines of interrelation of algebra and geometry and the early use of the idea of derivations.

37. **Tropfke, Johannes.** Geschichte der elementar-mathematik in systematischer darstellung. Leipzig, Veit und comp., 1903. viii, 496 p. 8°.

Covers the ground from the elements of arithmetic to analytic geometry, inclusive. Topically arranged, usable and thorough.

38. **Wisconsin state teachers' association.** Report of Committee on The content of algebra for high schools. Bulletin of information 14. Also a revision of the content of geometry for high schools. Bulletin 12. (Issued by State supt. C. P. Cary, Madison, Wis.)

39. **Young, J. W. A.** The teaching of mathematics in the elementary and the secondary school. New York, Longmans, Green and company, 1907. xviii, 351 p. 12°.

Scope indicated by title. Contains twelve bibliographies at the beginning of chapters, numerous other references in the text and (p. 156–59, 171–75) lists of books for the teacher and the library

40. ———— The teaching of mathematics in the higher schools of Prussia. New York, Longmans, Green and company, 1900. xiv, 141 p. 16°.

Treats the organization of these schools in general, the teaching of mathematics in detail, and the suggestions this work offers to Americans.

NATURE STUDY.

1. **Bailey, Liberty Hyde.** The nature study idea. New York, The Macmillan company, 1909. ix, 246 p. 12°.

A collection of essays on nature study as a phase of education. Contains numerous practical suggestions for teachers.

2. ———— The outlook to nature. New York, The Macmillan company, 1905. ix, 296 p. 12°.

A collection of essays valuable for the point of view expressed.

3. **Bigelow, Edward Fuller.** How nature study should be taught . . . New York, Hinds, Noble and Eldredge [1904]. xxi, 203 p. front., plates. 12°.

A collection of essays intended to give teachers inspiration, general direction, and outlook regarding nature study.

4. **Burkett, C. W., Stevens, F. L., *and* Hill, D. H.** Agriculture for beginners. Boston, Ginn and company, 1903. xii, 267 p. Illus. 12°.

Most of the many books on elementary agriculture are distinctly adapted to secondary schools, but this book has much material in line with nature study.

5. **Burroughs, John.** A year in the fields. Boston and New York, Houghton, Mifflin and company, 1896. ix, 220 p. 12°.

Valuable from the point of view of a nature observer.

6. **Cornell university nature study leaflets.** Albany, N. Y., The J. B. Lyon company. 607 p. Illus. 8°.

A collection of the leaflets published from 1896–1904.

7. **Coulter, J. M., *and* J. G., *and* Patterson, Alice J.** Practical nature study. New York, D. Appleton and company, 1909. ix, 354 p. 12°.

A discussion of principles, topical outlines, and lesson plans for nature study and elementary agriculture.

8. **Cummings, H. H.** Nature study by grades: Teachers' book for primary grades. New York, American book company, 1908. 180 p. 12°.
   A very helpful series of lessons adapted to primary schools in widely separated localities.
9. **Dearness, J.** How to teach the nature study course. Toronto, Copp, Clark and company, 1905. 206 p. 8°.
   Intended for Canadian schools, but very suggestive for teachers elsewhere.
10. **Goodrich, C. L.** The first book of farming. New York, Doubleday, Page and company, 1905. xx, 259 p. 12°.
    An excellent introduction to principles of gardening and the plant side of agriculture.
11. **Guyer, M. F.** The question of method in nature study. Pedagogical seminary, 12:86–92, March 1905.
    Also in Nature study review, 3: 228–35, November 1907.
12. Hampton Leaflets. Hampton, Va., Hampton institute, Nature study bureau. About 50 cents per dozen. Illus.
    A valuable series of leaflets dealing with nature study and agriculture. Published monthly.
13. **Hemenway, H. D.** Hints and helps for young gardeners. Hartford, Conn., pub. by the author, 1906. 58 p.
14. ———— How to make school gardens. New York, Doubleday, Page and company, 1903. xvi, 107 p. Illus. 12°.
    A manual useful for teachers unfamiliar with gardening.
15. **Hodge, C. F.** Nature study and life. Boston, Ginn and company, 1902. xvi, 514 p. Illus. 12°
    One of the two best known books on nature study. A brief discussion of principles in the first chapters is followed by many chapters dealing with biological materials in an interesting and suggestive style.
16. **Holtz, F. L.** Nature study. New York, Charles Scribner's sons, 1908. xiv, 546 p. Illus. 12°.
    The first part deals with general principles, the second part with subject matter, chiefly biological. A very practical book for teachers in training and others who have had no training in nature study materials and methods.
17. Illinois leaflets on agriculture. Taylorville, Ill., C. M. Parker. Pub. monthly. 25 cents per year.
    An extensive series of leaflets on agriculture by professors of the University of Illinois, full of useful suggestions.
18. **Jackman, Wilbur S.** Nature study for grammar grades: A manual for teachers and pupils below the high school in the study of nature. New York, London, The Macmillan company, 1901. 407 p. 12°.
    Several books with similar titles were published by this author, all of which are out of line with the present interpretation of nature study, but are useful for reference in preparing outlines and lesson plans.
19. **Jenkins, Oliver P., *and* Kellogg, Vernon L.** Lessons in nature study. San Francisco, The Whitaker and Ray company, 1900. 191 p. Illus. 12°.
    A collection of lesson plans chiefly on plants and animals, but some on physical nature study.
20. **Lange, Dietrich.** Handbook of nature study, for teachers and pupils in the elementary schools. New York and London, The Macmillan company, 1898. xvi, 329 p. Illus. 12°.
    Suggestions regarding materials, chiefly biological, profitable for nature lessons, especially in the eastern part of North America.
21. **Lloyd, Francis E., *and* Bigelow, Maurice A.** The teaching of biology in the secondary school. New York [etc.], Longmans, Green and company, 1904. viii, 491 p. 12°. (American teachers' series.)
    See chapter 2 on Nature study.
22. Massachusetts nature leaflets. Boston, State board of agriculture. Illus.
    Issued serially for a number of years.
23. **McMurry, Charles A.** Special method in elementary science for the common school. New York and London, The Macmillan company, 1905. ix, 275 p. 12°.
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24. **McMurry, Lida B.** Nature study lessons. New York, The Macmillan company, 1905. xi, 191 p. 12°.
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26. **National education association of the United States. National council of education.** Report of the Committee on industrial education in schools for rural communities, July 1905. [n. p.] The Association, 1905. 97 p. 8°.

27. **Nature study review.** Pub. at Urbana, Ill., by American nature study society. $1.00 per year, 9 nos.

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Criteria of selection of material for the teaching of nature study and geography. Caldwell, Otis W. 3:252-59, December 1907.

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28. **Overton, Frank, *and* Hill, Mary E.** Nature study; A pupil's textbook. New York, Cincinnati [etc.], American book company [1905]. 142 p. Illus. 12°.

Lessons for a year's study of common objects.

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10. **Coulter, John M.** What the university expects of the secondary school. School review, 17:73–84, February 1909.
11. **Dean, John Candee.** Count Rumford. Popular science monthly, 73:32–51, July 1908. Illus.
12. **Denslow, Van Buren, *and* Parker, Jane Marsh.** Thomas A. Edison and Samuel F. B. Morse. New York, Cassell and company, 1887. 128 p. 12°.
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15. **Franklin, Benjamin.** Autobiography. New York, Cassell and company, 1886. 734 p. 24°.
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    "My experience is, most emphatically, that a student may measure a thing and know nothing at all about it, and I believe that the present high school courses in elementary physics in which quantitative laboratory work is so strongly emphasized are altogether bad—I believe that physical sciences should be taught in the secondary schools with reference primarily to their practical applications—I can not endure a so-called knowledge of elementary science which does not relate to some actual physical condition or thing—either you must create an actual world of the unusual phenomena of nature by purchasing an elaborate and expensive equipment of scientific apparatus, or you must make use of the boy's everyday world of actual conditions and things."

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