Canadian Biology Teaching: An Historical Perspective

• *Stanley Norris, University of Alberta, Calgary, Canada*

The author is Associate Professor of Curriculum and Instruction and presented this paper to the joint meeting of the teaching societies at the AAAS in Montreal, Canada, in December, 1964.

As an investigator researches a slightly familiar area data are unearthed very slowly at the beginning. For instance, when I first received a request to participate in this discussion I was able to locate only three volumes related to this topic. Further investigation yielded government documents, old gazettes, theses from Eastern Canada, and volumes of a general nature on the history of education in Canada. Data from these sources yielded a myriad of interesting observations.

Canada is a very young nation educationally. Our first grammar school was endowed in 1807 after an unsuccessful attempt nine years earlier. Not until 1841 were Common and authorized Roman Catholic schools officially recognized in Upper and Lower Canada. By 1846 Upper Canada's School Act was made law under the direction of Egerton Ryerson, the Chief Superintendent. This Act partially removed educational chaos existing in some 651 Common Schools and 12 Grammar Schools—all operating totally independent of each other. Of the period prior to 1864 Hardy and Cochrane wrote: (8, p. 188)

> **"... teachers in Ontario had been working in helpless isolation without direction or assistance. They were utterly untrained, there was no course of study, and, worst of all, there was no uniformity of textbooks even within the same class. . . . The report of 1846 raised the hearts and hopes of all the struggling Common School teachers in the province, for it meant the end of chaos."**

In 1848 the Protestant Board of School Commissioners of the City of Montreal reported that, "... not one efficient teacher was at this time procurable in Lower Canada..." (14, p. 97)

During the forty-eight years from 1793 to 1846, biology courses—whether they be called natural history, elementary science, botany, zoology, agriculture, or physiology—were notable for their absence. For example, there was no biology mentioned in the York Common School curriculum of 1821. Its formal course of study consisted of reading, writing, spelling, parsing, and analyzing. Pupils memorized arithmetic tables, used the New Testament as a text, and recited the Catechism weekly.[3] Apparently at this time we had in the classroom many Canadian teachers who could do little else. Simultaneously we had teachers from across the border whom the authorities viewed as "American Wanderers." Perhaps this dearth of biology was due to a lag in elementary education. Because our universities and high schools were directed toward the education of the upper class, thereby earning the label of *exclusive,* these two were in operation some fifty years prior to the opening of our elementary or common schools.

Before 1846 biology or nature study courses were doubtless taught incidentally and on rare occasions they occupied a place on the timetable. At his private school in Cornwall, Ontario, John Strachan taught nature study at least once a week. His unique method of having each boy prepare twenty questions allowed a student at the "foot of the class" to ask a question of his immediate neighbor. A correct response entitled the neighbor to question another. Strachan experienced such success that he recommended the subject for all Grammar Schools in 1829. Seven years later Duncombe proposed the same subject but neither suggestion was acted upon. (4, p. 163) Ryerson's Report, 1846, listed two columns of courses and indicated that the second included sub-

jects toward which the better schools might aim. Natural history and agriculture appeared there. In order of their importance the subjects listed were: (8, p. 187)

I.	*II.*
Bible History and Morality	History
Reading and Spelling	*Natural History*
Writing	Natural Philosophy
Arithmetic	*Agriculture*
Grammar	Human Physiology
Geography	Civic Government
Linear Drawing	Political Economy
Vocal Music	

Although natural history and agriculture were finally given official recognition with this Report we must remember that inspectors were favorably impressed by pupils "... who were docile and obedient, who absorbed and memorized without questioning . . ." (8, p. 194) Even science teachers must have taught to these ends. One of the earliest references to biology requirements in teachers' certificates appeared in the 1870's.(1, p. 358) Botany and human physiology completed the list of subjects studied by the prospective teacher.

Educational progress evolves not only by invention from within but also by borrowing from without. Ryerson was given an opportunity to travel extensively in the United States and on the Continent. He returned with firm convictions about the curriculum outlined in his report of 1846, and with *other* educational ideas. From Massachusetts he borrowed the concepts of school boards, an agrarian tax base for educational purposes, and a system of government grants based on a school district's conformity to government regulations. Prussia was his source for the idea of a central government control. Ireland exported the notion of uniform texts and the Christian tone of our schools. At that time the sociology of our country was amenable to both Protestants and Roman Catholics accepting the Irish National Textbooks. New York was the source of individual school machinery and Germany of our system of normal schools.

Shortly after the Government of Upper Canada's acceptance of the Ryerson curriculum emphasis on the sciences began to appear. By 1885 physics, chemistry, and biology were generally accepted. (see Table I) Before this date chemistry outranked biology in popularity. In fact, chemistry had the unchallenged position of being thought the best medium for the development of scientific attitudes; (4, p. 76) a proposition soon questioned by the champions of botany and physics. Exponents of these two sciences challenged chemistry's position because of the expensive equipment and because its teachers often failed to clean up after their demonstrations. D. F. H. Wilkins argued that the time required to teach, the risks of failure, and the dangers of engendering bad mental habits were paramount in the teaching of chemistry. (4, p. 78) Such dangers, he felt, were not so common to either botany or physics.

Table I.
Minister's Reports of Attendance in Physics, Chemistry and Biology for Certain Years

Year	Physics	Chemistry	Biology
1880	2519	*2991*	0
1885	6939	3616	2685
1889	5868	3024	*6036*
1895	9887	5671	*11941*
1898	11002	5489	*12892*
1901	10265	5723	8626

References to specific papers on biology at various conventions of the Ontario Education Association evidence interest in biology teaching. At the Association meeting, 1878, Huxley's outline of the nature of biology, his enumeration of the advantages to be gained from a study of biology, and the methods he recommended for its systematic study, were favored by Professor R. Wright of University College. (7, p. 82) Instead of so much dependence on abstruse mathematics and precise orthography, David Boyle, at the twentieth annual convention of the Association, concluded that curriculums should emphasize Canada's immense physical resources and great natural beauties. Uninteresting instruction, he insisted, frightened children away from their schools. (9, p. 90) Outdoor excursions and studies of botanical, zoological, and geological specimens were urged by Boyle. In 1895 the Ontario Education Association hosted the Dominion Education Association. One of the papers highlighting this

large convention was, *A Wider Botany for High Schools,* by A. Stevenson. He advocated certain premises, of interest to us because of their contrasts with some of the curriculums financed by the National Science Foundation. (7, p. 159) Botany, he concluded, should not be taught as a pure science but should:

1. Create new interest for farmers.
2. Stress the beauty of plant color.
3. Relate to everyday activities.
4. Emphasize proper crops for certain soils.
5. Cultivate drawing and artistry.
6. Encourage soil cultivation of fruits and gardens.

One might refer to the years between 1889 and 1900 as the "period of biology" on the basis of pupil enrollment. (see Tables I and II) (4, p. 76)

Earlier I referred to borrowing as a way of contributing to educational change. Some time after 1850 Upper Canada educators borrowed the method of "Object Teaching" from Pestalozzi only after it had been rather inauspiciously introduced to Philadelphia in 1809 and accepted years later by Iowa. In order to encourage the adoption of this method the Minister of Education for Upper Canada included excerpts of an Iowa report in his proposal.

Table II
Percentage of Students in All Ontario Ontario Collegiate Institutes (CI) and High Schools (HS) Electing Certain Sciences Between 1887 and 1902

Date	Physics CI	Physics HS	Chemistry CI	Chemistry HS	Botany CI	Botany HS	Zoology CI	Zoology HS
1887	—	33%	—	25%	—	26%	—	—
1890	35	28	18	15	37	28	1	1.5%
1892	33	25	18	15	35	23	2	0.5
1894	36	26	20	17	31	21	2	0.5
1900	43	48	24	29	43	49	2	0
1902	—	52	—	24	—	36	—	1

According to the Iowa report there was no education era more distinguished than that introduced by Pestalozzi. (9, p. 282) He was credited with originating the most signal reform in the training of young minds. This great educator started with the assumption that all methods of instruction to be normal, should be natural. The child, he continued, is preeminently a creature of sense living in a world of objects, so objects and not abstract names and propositions should be the material of its study. The report continues: (9, p. 282)

". . . Things and not words, that was the motto. Give the child what it can see, and hear, and feel; and from the known properties of such objects it will ascend by the common route of all true discovery to other attributes which are yet to be known. Pestalozzi plied his contemporaries with the question, how in the first instance is the area of human knowledge extended in any line of research whatever? Since the days of Bacon men were asking Nature questions, and she never failed to respond eventually to their inquiries. And now the theory was, that the children, under the direction of a competent Teacher, should make up their own discoveries in some way.

"It will suffice to say that the System he inaugurated spread itself rapidly throughout the European States, and extended itself into our own Country. It practically gave Prussia its peerless system of Public Schools, which has been the pole-star of Educationists in all other parts of the civilized world. Whatever of superiority that system has, it was directly to the infusion of Pestalozzianism in it and the new moral impulse which the whole work of popular instruction received through that movement. Commending itself to the great minds of all Countries, it was transplanted, almost within the life time of its founder, to Prussia, Germany, Sardinia, Greece, Denmark, England, and many of the Colonies of Great Britain, . . ."

Not infrequently American superintendents borrowed from our culture. J. N. McJilton, Baltimore, wrote of his observation of "Object Lessons in the Girls' Model School," as one of the most interesting events of his visit. (10, p. 318-9) The teacher permitted him to select the topic of the lesson from a large number of pictures placed in grooves along the walls of the classroom. McJilton

chose a natural history picture depicting a camel and a cow. Teacher questions related to the class of these animals, their character and habits, the similarities and dissimilarities of both, peculiarities and uses of the camel and cow, and the countries in which each lived. The little six- to ten-year-old girls' responses were described as surprisingly accurate as they continued to answer questions related to adaptations to work and climatic conditions including stomach and food peculiarities of each.

Following this extreme emphasis on "Object Teaching," natural science (biology) teaching was described as becoming less scientific and more literary. (16, p. 488) It was also variously described as developing a romantic or wonderland treatment. Philips blamed this transformation on women as they had become the dominant sex in elementary school teaching by 1885. A textbook in use in the Maritimes, Mary A. Swift's *First Lessons on Natural Philosophy for Children,* listed questions and pat responses:

> **"Is the sun useful to us? It is very useful. In what way is it useful? It gives us light, so that we can see, and it makes us warm . . .**
>
> **"Is Philosophy a useful study? It is very useful, and a very pleasant study, too. What good does it do to children to learn it? It explains so many things . . ."**

Even in these early days science, and hence biology, received only a minor place in the elementary school curriculum. Table III, adapted from Phillips (16, p. 437) illustrates percentage distribution of time. Three percent of a seven hour school-day was recommended for science in Nova Scotia schools in 1867. By 1900 actual practice dropped to two percent.

At the turn of the century status studies indicated that the vogue of "Object Teaching" had lost is appeal. This method was rarely if ever mentioned. A letter from D. J. Groggin, Superintendent of Education for the North-West Territories, to an Official of the Dominion Department of Agriculture made no mention of the method under discussion. His correspondence dated 1901, stated: (13, p. 42)

Table III

Percentage of Time Devoted to the Study of Language, Arithmetic, Sciences and Formal Religious and Moral Instruction in Ungraded Elementary Schools for Pupils of 10 to 12 Years

Subject	1867 %	1900 %	1940 %	1940 %
	Nova Scotia	Nova Scotia	Ontario	Quebec
Language	43	48	30	40
Arithmetic	12	23	10	20
Science	3	2	10	2
Religious and Moral	18	5	—	15

> **". . . The pupil must study the plant, the animal and the soil rather than book descriptions of them. He may consult books after he has made his observations. The study of plant life should be emphasized in spring though not restricted to that season. . . ."**

In 1902 Silcox also referred to the study of natural objects as opposed to pictures, because these were considered of first interest and all interest was based on use. (17, p. 12) He contended further that a study of form accentuated one's power of observation. Support for stronger curriculum emphasis on nature study came from the conviction that this course required all modes of expression (17, p. 11) as illustrated in Table IV.

Table IV.

Subjects of Study	Modes of Expression
Arithmetic	Diagrams and Speech
Grammar	Diagrams and Speech
Literature	Speech
History	Speech
Geography	All Modes
Physiology	All Modes
Nature Study	All Modes

Silcox's reasons for not including reading, writing, drawing and composition was that these "so-called" subjects were simply modes of expression. He continued: (17, p. 11)

> **". . . By the act of placing them on the curriculum . . . the evil has been intensified, and we are compelled to witness meaningless exercises in combining sen-**

tences, filling blank spaces, correcting false syntax, changing the forms of sentences, the conjugation of the verb, under the name of composition. . . ."

He had an interesting explanation on the use and type of diagram for biology. (17, p. 5)

". . . **in the world of science, at least, it is more important than drawing. It is scarcely possible to make a drawing that would have any scientific value. At any rate, it is of far less value than a good diagram, which expresses a general principle. . . .**"

His writings divided children's growth patterns into three entities:

1. Infancy to 8 —impressionistic period,
2. 8 to 12 —retentive period,
3. 12 plus —relationships period,

and he developed both model lessons and a total nature study curriculum based on these premises.

Nature study was given a definite place in the Ontario curriculum after a revision in 1904. (11, p. 18) It now included plants, animals, minerals, physics, chemistry, geography, physiology, hygiene, agriculture (soils, fertilizers, seeding and harvesting) and school gardens. This crowded curriculum was described as suggestive rather than prescriptive. The Report of the Minister of Education, 1904, stated that:

". . . **Notes shall not be dictated by the teacher. Mere information whether from book, written note or even the teacher, is not Nature Study. The acquisition of knowledge must be made secondary to awakening and maintaining the pupil's interest in nature and to training him to habits of observation and investigation.**"

Trends away from the literary and pictorial methods of teaching biology content continued. An Ontario Teacher's Manual, 1901, emphasized that method must involve much practical work. (15, p. ii) Lower School objectives for biology were listed as (1) a broad view of plants and animals; (2) a habit of thinking about plant and animals; (3) an appetite for further enquiry by observation and reading. On drawings the author of this volume stated that, ". . . no one has seen an object aright until he has made a drawing of it . . ." and further, ". . . the making of a drawing or the statement of a fact in natural history involves a moral responsibility. They are exercises in truthtelling . . ." (15, p. 17) Some elements of the first two years of high school biology taken from this manual are given in Table V.

Table V
Province of Ontario

First Year of Biology		Second Year of Biology	
Fall	**Spring**	**Fall**	**Spring**
Common flowering plants	Germination	Composites	Trees
Structure	Artificial propagation	Weeds	Flowering plants
Function	Spring flowers	Fungi	Grass
	Roots	Physiology	Ferns
	Stems		Economic plants
	Leaves		Review

Amos indicated that in 1912, 15,000 Ontario lower school pupils were registered in biology of a total school population of 19,829. (2, p. 61) This enviable position was lost by 1923, but this was not nearly so severe as the loss suffered by zoology, the same year.

When Miller discussed prescriptive and restrictive courses of study for Canada's rural schools he noted that all provinces held hygiene with physiology and nature study as mandatory, by 1913. (12) Nature study had a strong agricultural and horticultural tone. With reference to each province he noted that all gave some work in "Object Lessons" and familiar science; that Manitoba published a special outline; that Ontario and Quebec issued periodic circulars; that Protestant Quebec had use of the agriculture facilities of Macdonald College; and, that New Brunswick had no such facilities to augment the teaching of agriculture and horticulture.

From the writings of Dyde in 1929 one can obtain data on the relative importance of elementary science (botany, zoology, physiography, general science, elementary science) for at least five provinces. Using a common base of twelve subjects for each province the over all relative position of science for Nova Scotia, Ontario, Saskatchewan, Alberta, and

British Columbia was 6/12. Nova Scotia placed science at 11/12, Ontario at 4/12, Saskatchewan at 8/12, Alberta at 3/12, and British Columbia placed it as low as possible 12/12. (5)

Another indication of the status of the sciences and biology in particular can be adapted from the annals of the Federal Government. Statistics related to Nova Scotia, New Brunswick, Ontario and Saskatchewan were available. (6, p. 74-7) In 1935 biology was offered as a high school science in only two of these provinces. (See Table VI, p. 13)

In the early twenties elementary school curriculums began placing less emphasis on biology in order to include topics on the earth, universe, energy and machines. Less time allotted to biological phenomena may have resulted in a lesser importance being attached to this science at the high school level. In the anomaly illustrated by the graphs, one wonders if the situation parallels the very early nineteen hundreds when seemingly a major change in the biology curriculum was not preceded by a period of in-service education.

This abridged history of biology teaching in the Dominion of Canada between 1800 and 1935 sustains two educational generalizations. Firstly, from its conception, curriculum reform must include the classroom teacher. Secondly, Department of Education officials must support innovation through financial aid.

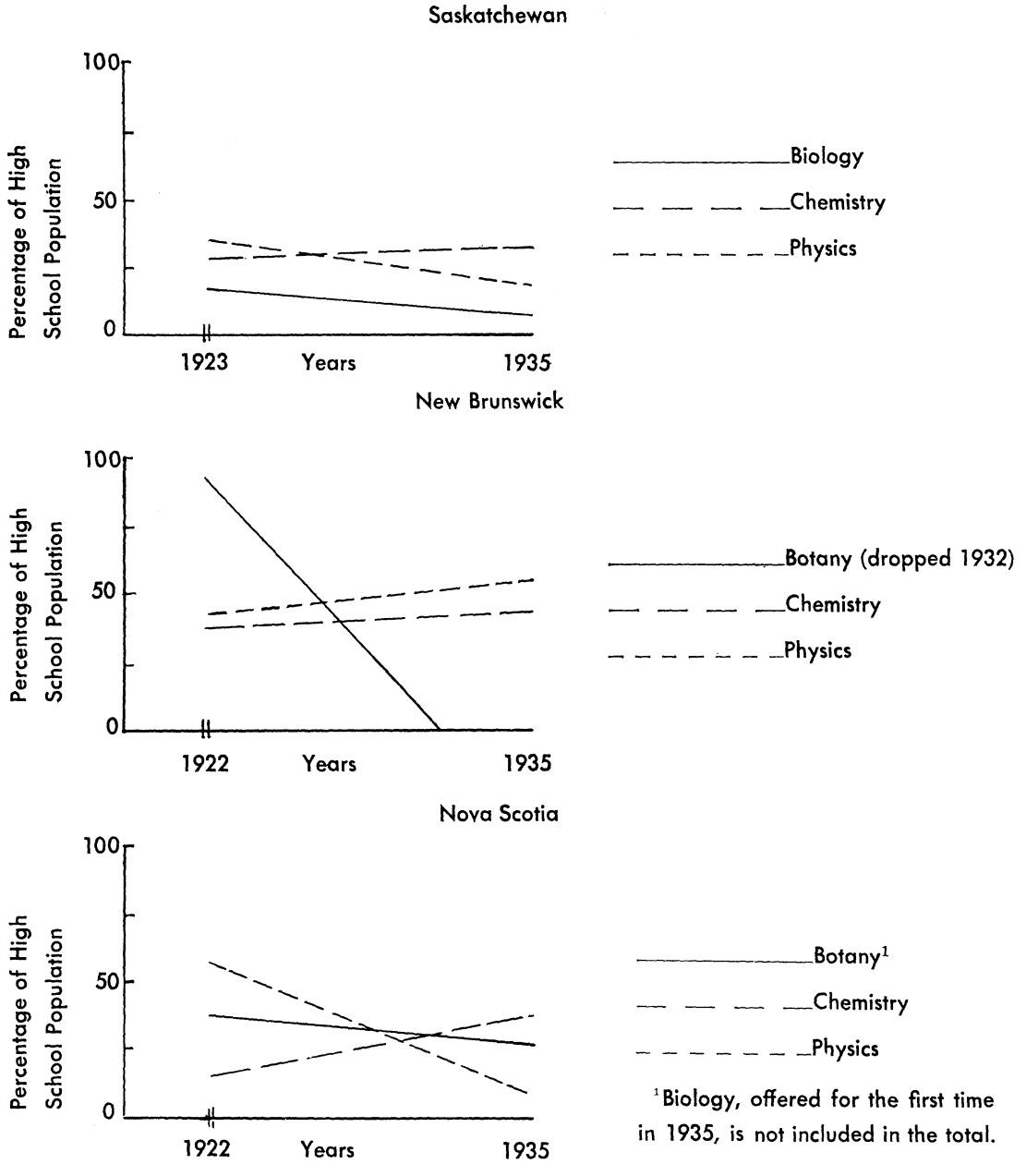
Table VI

Pupils in Certain Public School Grades in Certain Provinces Registered in Science Courses for the Year 1935

SUBJECTS	Provinces			
	Nova Scotia	New Brunswick	Ontario	Saskatchewan
Physics	545 (XII)	1671 (X) 1411 (XI)	10205 (XII) 2849 (XIII)	1077 (XI)
Botany	6572 (IX) 163 (XII)	– –	9653 (X) 2316 (XIII)	– –
Chemistry	3713 (XI) 727 (XII)	1526 (X) 1410 (XI) 24 (XII)	9153 (XII) 3135 (XIII)	1474 (XI) 1077 (XII)
Biology	4052 (X)	–	–	724 (XII)
Zoology	–	–	7300 (X) 2263 (XIII)	–
Agricultural	–	–	9153 (X) 3153 (XII)	572 (XI)
Total classified	IX–6798 X–4841 XI–4346 XII–1091	IX–2746 X–1842 XII– 24 XI–1431	L.S.[2] –36036 M.S.[3]–24162 U.S.[4]– 8279	XI–2729 XII–1893

1. The statistics given in this table relate to Ontario Collegiates and High Schools.
2. L.S. –stands for Lower School.
3. M.S.–stands for Middle School.
4. U.S.–stands for Upper School.

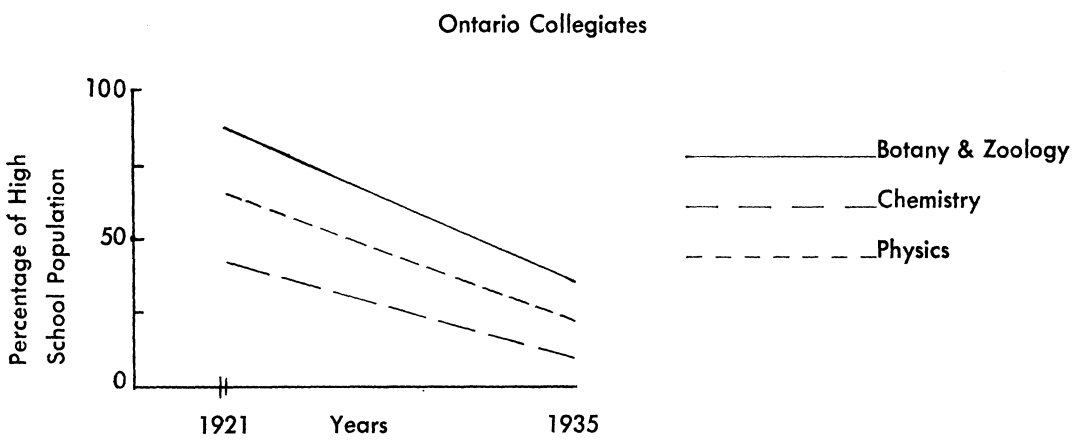
Between 1922 and 1935 biology suffered greater losses in enrollments than either physics or chemistry in at least four of Canada's provinces. This observation is supported by Dominion Bureau of Statistics data presented in graphical form below. (6, p. 74-7)



Statistical evidence verified that biology, after a very slow beginning, had at least two ascendancies in pupil enrollment. Mainly by stressing the methods of "Object Teaching" and a literary approach biology outranked physics and chemistry by 1898. An analysis of the data indicated that this first reign of biology followed a fairly active effort on the part of professional educators. These men motivated practicing teachers through professional association meetings.

Conversion preceded ascendancy. Coincident with decreased enrollment, starting in 1901, was a marked change in method. By 1913 biology was again in vogue with active government support in the form of in-service programs, specific facilities and periodic publications.

Official financial involvement paralleled ascendancy. An interesting parallel between Canada and the United States became apparent. Biology was the last science, in two in-



stances, to gain popularity in Canada. Current curriculum revisions in America were initiated by the Physical Science Study Committee in 1956, by the Chemical Bond Approach Committee in 1957, and by the Biological Science Curriculum Study group in 1959.

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Cover Picture

Thomas Aylesworth's article on page 597 tells something of the heritage of Louis Agassiz whose picture is carried here.