new. Since the inspiring example of Huxley, at least, scientists have been making contributions to education and have been taking part in its councils. The members of our Academy and the organization officially have indicated active interest in educational matters. Witness the symposium on the nature and content of first courses in psychology held this afternoon and the papers listed in the Chemical Section for the Round Table Discussion on Chemical Education tomorrow morning. Attention to these matters has been increasing. They demand still deeper study.

I have endeavored to call attention particularly to the needs and opportunities of the present day in education in Virginia and the relation of scientists to it. It is my earnest belief that, in view of existing conditions, the scientists of Virginia should consider most carefully the scientific needs of the industrial situation; that they should give greater attention to educational problems and opportunities, that they should examine with assiduous care their teaching methods and aims, should play an increasing part in the solution of educational problems and should influence more effectively the educational policies of the State.

Believing as I do that scientists should concern themselves with education and express themselves freely upon its problems, I have been impelled to take this occasion to practice, as fully as the occasion and the state of my ignorance permit, what I have preached. None can be more conscious than I of the need for substituting conclusions rigidly drawn after painstaking observation and experiment for opinions such as I have expressed. However, opinions, recognized as such, have a real place in the advancement of knowledge. If they provoke vigorous controversy, all the better so long as it is good tempered and on a basis of mutual respect, and provided it leads to further investigation and to decisions based upon knowledge rather than upon feelings and prejudice. It is with confidence that these propositions will receive such support as they merit and such opposition as they deserve that I lay them before the scientists and educators included in the Virginia Academy of Science and the Virginia Social Science Association and those interested in their concerns.

Donald W. Davis

GENERAL SCIENCE TEACHING IN VIRGINIA TODAY

THIS article considers the following topics: 1 The Place of General Science in the Modern School Curriculum, 2 Survey (partial) of General Science Courses given in Virginia in 1927-8, 3 The Training of General Science Teachers in the State Teachers Colleges of Virginia, 4 Survey of Textbooks, 5 Lack of Equipment, 6 Modern Methods of Teaching, 7 Worth-while Literature.

The above-mentioned topics constitute the high spots in a course on General Science given in the Summer School of the State Teachers College, Harrisonburg, Virginia, 1928.

1. *The Place of General Science in the Modern High School Curriculum*

General Science is fast winning for itself not only a permanent place in the high school curriculum but also a large place, if we may judge from the fact that the enrolment in this course in the United States is approximately equal to that of all other high school sciences combined.[1] There are several reasons why General Science has won this place for itself: The first and most important reason is that modern General Science courses actually meet the needs of the pupils in the first year high school. This

The following members of a Summer School (1928) class in the Organization of General Science co-operated in the preparation of this article: Sarah Hartman, Evelyn Kendrick, Maidie B. Hill, Christine Bolton, Alma Kline, Comena Mattox, Mollie Clark, and Viola Ward.

1. Frank—*How to Teach General Science*, p. 12.

is so because the subject matter has a psychological rather than a logical basis, *i. e.,* the content is aimed to satisfy the actual mental questionings on scientific subjects of pupils of that age without classification into the ordinary divisions of science (Chemistry Physics, etc.)

Another reason for the growing prevalence of General Science is that it offers an opportunity for the alert teacher to help the pupils with the modern scientific pieces of apparatus in their homes, viz., the radio, victrola, and automobile.

Moreover, General Science can easily be adapted to meet the needs of a particular community, *e. g.,* agricultural or industrial.

And General Science, through the interest it has aroused in the pupils, has served to keep a good many pupils in school who might otherwise have left too early.

Then this course has a good deal of vocational guidance value, as it touches on many sciences, and explores them in a general way, assisting the student to discover for himself to what extent his interests lie in that direction.

The importance of this course in the high school is attested by the fact that recently the Board of Regents of New York State have recognized it as a regular high school science, and by the further fact that all the large universities except one or two now accept General Science for admission.

2. *Survey (partial) of General Science Courses given in Virginia in 1927-8.*

Because of the vital importance of General Science to the high school pupil, an attempt was made to secure data on the course as at present given in the state. Information was gained through interviews with teachers assembled for the summer session at the State Teachers College, Harrisonburg, Virginia, in the summer of 1928. The data secured is recorded in Table No. I, page 239.

From this table one can see that General Science is almost always taught in the eighth grade (first year high school). This is followed up by a course in Biology in the second year, and Physics and Chemistry, alternately, in the third and fourth years. The time alloted to General Science in most schools is as follows: three recitation periods per week, and two double laboratory periods, as recommended by the state.

The text used in almost every case is *Introduction to Science,* by Bertha M. Clark, published in 1915. Just recently a 1928 edition of this book has been published. (See review elsewhere in this issue.) Miss Clark's book is one of the two texts adopted by the state, the other one being Hessler's *Junior Science.*

It is unfortunate that Virginia, whose public school system has made decided progress in the last twenty years in several lines, should be unprogressive in the matter of adoption of textbooks. If it is not feasible to leave the adoption of textbooks to the teachers, as poorly prepared as they sometimes are at present, at least a longer list of textbooks should be approved.

3. *The Training of General Science Teachers in the State Teachers Colleges of Virginia.*

The value of a teacher's work depends a good deal both on the quality and the quantity of training. Table No. II, on page 240, shows the natural science courses given by the Virginia State Teachers Colleges.

The two year courses, preparatory to teaching in the grades, offer only two sciences, namely, Nature Study and Hygiene.

The four year courses preparatory to high school teaching offer at least two special sciences, but only one college, Fredericksburg, offers a course in General Science to high school teachers.

In the judgment of the writer the minimum requirement of twenty-four semester-hours of "content" courses for high school teachers is decidedly not enough. General Science teachers usually have to teach one other science, and they should have taken at least two college courses in that science before teaching it, and preferably three. And

for the teaching of General Science, teachers should have more science than the three fundamental ones, Physics, Chemistry, and Biology. There should be one course in Astronomy, and one in either Geology or Physical Geography. Such an increased emphasis on the subject matter would help to raise the scholastic standards of the Teachers Colleges to those of the first-class liberal arts colleges. The need for more thorough training in subject matter for high school science teachers was emphasized in the recent conference (April 11, 1928) on Natural Science Education, Teachers College, Columbia University, particularly by Professor N. Henry Black of Harvard, and Professor Victor La Mer of Columbia.

It may be worth while to add a few thoughts on certain characteristics of the progressive teacher. This teacher will keep in close touch with modern scientific news, both while in college, and in teaching service. She will call the attention of her students to accounts of modern inventions and experimentations in the newspapers, periodicals, and scientific magazines. The "dynamic" teacher will not only interest her pupils in science but will arouse the community and set the people to thinking scientifically. The stirring up of the community will also react in a stimulating way on the pupils.

4. *Survey of Textbooks.*

As one of the projects in the class, the members reviewed nine modern General

TABLE I

SURVEY OF GENERAL SCIENCE COURSES IN HIGH SCHOOLS

Location	*Grade in Which Course is Taught*	*Recitations Per Week*	*Lab. Periods Per Week*	*Other Sciences Taught*
Apple Grove ...	4th yr. H. S.	5—45 min.	2—45 min.	H. Ec., Agri., and Biology
Brandy	8th grade (1st yr. H. S.)	3—45 min.	2—45 min.	Biology
Bridgewater	1st yr. H. S.	3—45 min.	2—90 min.	Biology and Chemistry
Broadway	1st yr. H. S.	3—45 min.	2—45 min.	Biology and Chemistry
Brunswick	8th grade	3—40 min.	2—40 min.	Biology and Chemistry
Callands	8th grade (1st yr. H. S.)	5—45 min.	2—45 min.	Biol., H. Ec., Physics and Chem.
Crozet	8th (1st)	3—45 min.	4—45 min.	Biol., Chem., and H. Ec.
Dayton	1st yr. H. S.	3—45 min.	2—90 min.	Biology
Edom	1st yr. H. S.	3—60 min.	2—60 min.	Biology and Chemistry
Elkton	1st yr. H. S.	2—45 min.	3—45 min.	Biology and Chemistry
Front Royal	8th grade	3—40 min.	2—40 min.	Biology and Chemistry
Greenville	8th grade	3—40 min.		Biology and Chemistry
Halifax	not taught			Biol., Chem., and Physics
Harrisonburg ..	8th grade	3—45 min.	2—90 min.	Biol., Chem., Phys., and H. Ec.
Mt. Jackson	8th (1st yr. H. S.)	3—45 min.	2—45 min.	Biology and Chemistry
Leesburg	1st yr. H. S.	5—45 min.	2—45 min.	Biol., Chem., Phys., and H. Ec.
Lexington	1st yr. H. S.	5—40 min.	2—80 min.	Biology and Chemistry
Loudoun	8th grade			Chemistry and Physics
Luray	8th grade	2—60 min.	3—60 min.	Biology and Chemistry
Manassas	8th (1st yr. H. S.)	1—45 min.		Biology and Chemistry
Matoca	8th grade	3—45 min.	2—45 min.	Biology
McGaheysville ..	1st yr. H. S.	3—60 min.	2—60 min.	Biology and Chemistry
New Castle	1st yr. H. S.	3—40 min.	2—40 min.	Biology and Chemistry
New Hope	1st yr. H. S.	5—40 min.	2—40 min.	Biology and Chemistry
Norfolk	8th grade	4—45 min.	2—45 min.	Biol., Chem., and Physics
Petersburg	8th (1st yr. H. S.)	3—45 min.	2—45 min.	Biology and Chemistry
Pleasant Valley .	8th grade	3—45 min.	2—45 min.	Agriculture
Richmond	1st yr. H. S.	3—50 min.	2—50 min.	Chemistry and Physics
Rural Retreat ..	1st and 2nd yr. H. S.	3—45 min.	2—45 min.	Bioolgy
Salem	8th (1st yr. H. S.)	3—45 min.	4—45 min.	Biol., Chemistry, and Physics
Saltville	1st yr. H. S.	5—40 min.	2—40 min.	Biology and Chemistry
Spottsylvania ..	Alternate yrs.	3—40 min.	2—40 min.	Biology
Stanley	8th (1st yr. H. S.)			Chemistry, Biology, Physics
Staunton	8th (1st yr. H. S.)	5—45 min.	1—45 min.	Chemistry, Home Economics
Timberville	1st yr. H. S.	3—45 min.	2—90 min.	Biology
Washington	8th grade			Biol., Chem., and Physics

Science textbooks for the high school, according to criteria proposed by Frank. This work was done to give the members experience in rating and selecting their textbooks. The result is a careful estimate of the marketed textbooks in this subject. The scores for each of the nine books are given in Table III, page 241.

In order to illustrate the thoroughness with which the books were scored, there are given below the questions raised under the first heading, "Selection of Subject Matter," each one of which had to be scored for *each* book:

A. Does the subject matter cover the minimum essentials based on environment, activities, and interests of the pupils in any community? (Perfect score equals 6.)

B. Does it provide a body of very important supplementary materials for strong classes (near essentials)? (Perfect score equals 6.)

C. Does it provide a body of additional materials particularly fitted for this specific locality (local essentials)? (Perfect score equals 6.)

D. Is all the material socially worth while and does it lend itself to the accomplishment of the aims of secondary education? (Perfect score equals 6.)

E. Is the subject matter adapted to the age and preparation of the pupils of the grade in which the subject is given in my school? (Perfect score equals 6.)

By Table III one can tell which items of the books in the opinion of the scorers, reach the standard and which do not. For example, the first, fourth, fifth, seventh, and ninth books seem to fall down in their illustrations. Each feature of one book can easily be compared with the corresponding feature of the other books. For instance, according to Frank's standard, no book is perfect in providing adequate information as to other sources of materials.

TABLE II

SCIENCE COURSES PREPARATORY TO SCIENCE TEACHING OFFERED IN THE STATE TEACHERS COLLEGES OF VIRGINIA

Colleges	*For Primary Teachers*	*For Grammar Grade Teachers*	*For High School Teachers*
Farmville	Nature Study Geography		General Biology General Chemistry General Physics Special course in Zoölogy, Botany, Entomology, Organic Chemistry, and General Experimental Physics.
Fredericksburg ..	Hygiene Nature Study	Hygiene Nature Study	General Science General Biology General Chemistry General Physics Organic Chemistry
Harrisonburg	School Hygiene Nature Science	School Hygiene Elementary Science	School Hygiene General Biology General Chemistry General Physics Advanced Physics Organic Chemistry Qualitative Analysis Quantitative Analysis
Radford	Nature Study	Nature Study	General Biology General Chemistry Organic Chemistry Analytical Chemistry

Note:—In the above table all courses for primary and grammar grade teachers are compulsory, while those for high school teachers are elective.

5. *The Lack of Equipment*

One of the greatest problems facing the well-prepared General Science teacher concerns equipment. The average school in Virginia is sadly lacking in this respect, due largely to the fact that principals and school boards do not appreciate the importance of this course. It should also be borne in mind that equipment is constantly wearing out and has to be replaced.

In the selection of equipment there are at least four determining factors, which are as follows: the present equipment, the number of students in the class, the outstanding method which the teacher will use, and the amount of money available for new equipment.

The alive and up-to-date teacher will realize that much of the minimum equipment may, if necessary, be devised by the students in the General Science classes. For example, alcohol lamps have been made by punching holes in the tin tops of cold cream jars, and inserting a loose round wick. Discarded photographer's boxes have been used as receptacles for a school museum. Glass jars and bottles of all kinds may serve as beakers. Discarded screen trimmings may be cut and used for wire gauze.

In many of the schools where the General Science equipment is meager or nil, the teacher has access to the laboratory equipment used in the other science classes. A better plan, however, is to have some equipment belonging exclusively to the General Science students that they may be proud of and responsible for. If the individual laboratory method of instruction is to be used for a large class, it may be practically impossible to have completed sets of apparatus without borrowing from the rest of the science department. Since, however, recent investigations have shown the lecture demonstration method to be superior in some respects to the individual laboratory method, the General Science teacher should have at least one complete set of apparatus for this type of teaching. For the worth-while ndividual laboratory experiments the teacher should borrow, if necessary, the required equipment. The progressive teacher will improve the laboratory equipment each year.

TABLE III

SCORES MADE BY LEADING GENERAL SCIENCE TEXTS

Criteria	*Perfect Score*	*Textbook Number* 1	2	3	4	5	6	7	8	9
I. Selection of subject matter	30	26	18	24	30	30	30	19	27	28
II. Organization of subject matter	20	19	19	20	20	20	20	16	20	20
III. Is the psychological organization of the book based on the learning process?	10	10	10	4	8	10	10	6	8	8
IV. Does the book provide information as to other sources of material?	10	2	8	8	9	5	7	2		
V. Is the book well illustrated	5	4	5	5	4	4	5	4	5	4
VI. Has provision been made for Laboratory Experiments and Projects?	5	3½	5	3	3	4	3½	3½	3½	3
VII. Is the material character of the book adapted to the purpose for which it is intended?	5	5	5	5	5	5	5	4½	4½	5
VIII. Is the book written in good, clear English that is in keeping with the age and preparation of the pupils?	5	4	5	5	5	5	5	5	5	5
IX. Is the book no more expensive than other texts of the same type?	5	5	5	4	5	5	5	5	5	5
X. Is the book adapted to the course of study in your school and the needs of your particular community?	5	4	5	5	5	5	5	3	5	5
Total scores	100	82.5	85	83	94	93	95.5	67.5	88	89

6. *Modern Methods of Teaching*

Attention is directed to the following methods:

I. *Lecture Demonstration.* The teacher performs an experiment before the class with appropriate questions and explanations. The students observe closely, and record observations. After performing a number of experiments at the beginning of the course, the teacher gradually transfers the burden of it to her pupils, who prepare and give the work before the class. Recent studies, according to Frank,[3] show "that this method, if properly handled, is the most economical and efficient method for imparting many of the understandings which are necessary, and for developing appreciations and powers of observation. Much of the laboratory work now done by pupils in General Science classes could be eliminated, and better results obtained in less time and at less cost by the lecture demonstration method."

II. *Project Method.*[4, 5, 6, 7] Kilpatrick[(4)] defines a project as a "whole-hearted purposeful act proceeding in a social environment." Frank defines the project as a problem, or series of related problems, in which the pupil conceives a problematic situation, believes it to be worth solving, and believes that he can solve it. Moreover, he *wants* to solve it.

The project properly carried out develops the pupil's self-reliance, initiative, and resourcefulness. It also provides a more natural method of procedure, and hence the old idea of training and discipline will carry over and function in everyday life.

III. *New Type Tests.* The teacher will want to use one or more of these tests each year in order to check up on her work and to improve her methods:

(1) Range of Information Test (use at beginning of first semester). 2) True-False Test, (3) Best-Answer or Selection Test, (4) Short-Answer Test, (5) The Completion Test, (6) Vocabulary Test, (7) Label-a-diagram Test.

IV. The following devices to gain and hold the interest of pupils may be mentioned: (1) Science clubs, (2) Science plays, (3) Scrap books, (4) Science bulletin boards, (5) Moving pictures, and (6) Exhibits. The two latter may be secured from industrial concerns, large universities, and the government. Write the U. S. Bureau of Education in Washington for information.

7. *Worth-While Literature*

Every General Science teacher should allow several dollars each year in her personal budget for periodicals and books for the sake of inspiration, and to keep in touch with the latest methods and materials. A brief list is given below. For fuller lists consult Frank's *How to Teach General Science,* Chapter XVI, and the Virginia State Course of Study in General Science.

TEXTS

Caldwell and Eikenberry—*Elements of General Science.* Ginn, 1926. $1.60.

Clement, Collister, Thurston—*Our Surroundings.* Iroquis Publishing Co., 1928. $1.70.

Pieper and Beauchamp—*Everyday Problems in Science.* Scott Foresman, 1925. $1.60.

Wood and Carpenter—*Our Environment.* Allyn and Bacon, 1927.

GENERAL REFERENCE BOOKS

Brownlee and others—*First Principles of Chemistry.* Allyn and Bacon. $1.60.

Downing—*Our Living World.* University of Chicago Press. $2.50.

Duff and Weed—*Elements of Physics.* Longmans. $2.20.

FOR THE TEACHER

Bulletin—*Reorganization of Science in Secondary Schools.* Bureau of Education, 1920, No. 26. 10 cents.

Frank—*How to Teach General Science.* Blakiston, 1926. $2.00. Very valuable.

Monahan—*Laboratory Layouts for the High*

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[3]Frank, *How to Teach General Science,* p. 80, 81.

[4]Kilpatrick, *General Science Quarterly,* I:67-72, 1917.

[5]Frank, *How to Teach General Science,* p. 91, 93, 94, 96, 97.

[6]Kilpatrick, *Foundations of Method,* p. 241, 344-8, 354-9.

[7] Bowden, G. A., *General Science Quarterly,* 344-8, 354-9.

School Sciences. Bureau of Education Bulletin, 1927, No. 22. 15 cents. (Excellent.)

PERIODICALS

Current Science (weekly). Looseleaf Education, Inc. 1123 Broadway, New York. $1.00. Special club rates to schools.

General Science Quarterly—W. G. Whitman, Salem, Mass. (Invaluable). $1.50.

The Science Classroom—250 Fourth Ave., New York City. 25 cents.

Fred C. Mabee and Others.

NEEDS OF HIGH SCHOOL LATIN STUDENTS AS REVEALED IN COLLEGE WORK

IT WAS with considerable reluctance that I consented to give this paper when your President approached me on the subject last spring, and as the time intervening between then and now has gone by, I have suffered many misgivings and qualms of conscience as I realized that I perhaps had little or nothing constructive to offer you in the way of criticism. I do, however, relish the opportunity of putting before you some of the absurdities arising from high school Latin as it is apparently taught, which I—and my colleagues in your colleges here in Virginia—are forced annually to face. I do this, understand me, with no sense of superiority, but only hoping that you may be interested in sharing with us some of our experiences.

I personally teach in what I believe is one of the best of the women's colleges in Virginia, one which draws students from all parts of the state—so I may assume, I think, that my knowledge of Virginia college students is pretty typical of the knowledge which other college professors in Virginia have of them. Our freshman requirement is such that the majority of our first year students take one year of college Latin. This is a course in Vergil's *Æneid,* if the student has come on to college with only three years of high school Latin; Livy and Horace if she enters with four years to her credit. In many instances it is amazing—nay, even appalling—what their three or four years of preparation in high school have failed to do for them, for to be perfectly frank, a large proportion of the students who enter college every year come atrociously prepared in Latin. I am far from being one who credits everything that students say, but when a thing happens repeatedly over a series of years, I do eventually begin to take some stock in it. And in my experience it has been no uncommon thing for freshmen to explain to me that ponies and trots have been countenanced throughout their high school course or that interlinear translations have been recommended. Such students usually flounder for a time and then become hopelessly overwhelmed in a sea of difficulties. They have no fundamentals of grammar. I have honestly had freshmen students who did not know an adverb from a noun, who had never heard of the present and historical perfects, to whom sequence of tenses was not even a name, and who persisted in following up verbs of saying and thinking with *ut* clauses (which to make matters even worse sometimes contained an infinitive instead of a subjunctive). Yet in spite of all this, their high schools have passed them on to us for college work—often even with straight A records. What are we as college professors to do? It is physically impossible for us in the few scattered hours which we can scrape together outside of the classroom to build up a background which a normal student acquires in no less than three or four years.

Every fall as the first freshman Latin quiz approaches, I am greeted on all sides by worried students who maintain that they have never taken Latin quizzes before and that they are therefore at a loss as to how to go about studying for them. Or again, regarding Latin prose composition, I find that quite a universal defense of bad prose papers is the statement that during the last