ORGANIZATION OF BIOLOGY AND RELATED SCIENCES IN CITY HIGH SCHOOLS.[1]

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During the spring of 1919 two hundred seventy-five questionnaires were sent out to academic high schools in some of the larger cities of the country. The schools were chosen from governmental reports of the Bureau of Education and from other sources. The selection of schools was made so that most of the cities with population over 50,000 were represented.

Probably as a result of the large amount of information requested, only a hundred and ten answers were received, but a wide range of country was covered, the answers coming from thirty-seven different states, and sixty-five different cities.

After the plan of the present work was rather completely thought out, it was found that it duplicated to some extent, a piece of work done several years previously.[2]

A comparative study of the results of 1910, and those obtained in 1919, has therefore been made in the expectation that some indication of the direction of change in organization and condition of biology and other sciences may be found.

The answers to the questionnaires are arranged in five groups according to the states that they represent: The *North Atlantic Division* consisting of Maine (1), New Hampshire (1), Massachusetts (11), Vermont (2), Rhode Island (2), Connecticut (2), New York (4), New Jersey (6), Pennsylvania (9), and Delaware. The *North Central Division*, of Ohio (8), Indiana, Illinois (6), Michigan (3), Wisconsin (3), Minnesota (1), Iowa (2), Missouri (4), Kansas (2), Nebraska (1), S. Dakota, North Dakota (1). The *South Atlantic Division*, of Maryland (1), District of Columbia (1), Virginia (2), West Virginia, North Carolina (1), South Carolina (1), Georgia, Florida (1). The *South Central Division*, of Alabama (1), Mississippi (1), Tennessee, Kentucky, Arkansas (1), Louisiana (1), Texas (2), Oklahoma (1); and the *Western Division*, of New Mexico, Colorado, Wyoming, Montana (2), Idaho, Utah (2), Arizona (1), Nevada, Washington (3), Oregon (1), and California (7). The numbers in parenthesis are the number of answers received from each state. Thirty-eight schools from

[1]See Patterson's American Educational Directory, Vol. XVII, by Homer L. Patterson, Amer. Educ. Co., Chicago; 1920.

[2]Hunter, G. W. Method, Content and Purpose of Biologic Science in the Secondary Schools of the United States. School Science and Mathematics, 10: 1-10, 103-111; 1910.

Science		N. Atlantic					N. Central					S. Atlantic					S. Central					Western					Total
		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4		
Botany	99	4	9	1	1	6	9	13	2	0	6	0	4	0	0	0	1	1	0	0	1	0	3	1	1	1	64
Zoology	99	0	5	2	1	5	1	9	2	2	3	0	4	0	1	0	1	1	0	0	1	0	3	0	0	1	40
Biology	99	9	8	7	5	5	3	3	1	0	3	0	3	0	1	0	0	2	0	1	0	1	5	0	0	1	58
Hygiene and Human Physiology	99	12	1	2	1	2	16	3	3	2	6	2	0	0	0	0	2	0	0	0	0	1	4	4	1	1	63
General Science	99	23	2	0	0	0	17	1	0	0	0	2	0	0	0	0	3	0	0	0	0	8	0	0	0	1	57
Physiography	99	2	5	2	4	0	6	4	0	1	3	3	0	0	1	1	3	1	0	0	0	6	0	0	1	0	43
Physics	99	0	4	23	5	10	0	0	12	6	2	0	0	3	3	1	0	1	3	2	0	0	0	7	4	0	86
Chemistry	99	0	1	7	23	8	0	1	6	9	5	0	0	3	2	1	0	0	3	2	2	0	0	7	4	1	85
Agriculture	99	2	2	2	2	0	4	3	5	4	5	0	0	0	0	0	0	1	1	1	0	2	1	1	0	0	36
Geology	99	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Astronomy	99	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Psychology	99																										2
Gas Engines	99																										1
Wireless	99																										1
Aeronautics	99																										1
		52	37	46	42	36	56	37	33	24	37	7	11	6	8	3	10	7	7	6	4	18	16	20	11	6	545

TABLE I.

the North Atlantic Division responded, thirty-one from the North Central, seven from the South Atlantic, seven from the South Central and sixteen from the Western, showing a complete total of ninety-nine answers.

Table 1 is a tabulation of the answers from the ninety-nine schools and shows the organization of the Sciences throughout the four years of school work. In this table the answers are classified according to the state from which they come, the division of the country to which they belong being shown in the spaces at the top. To the left, the first column gives the sciences studied. Each of the five columns is divided into five smaller parts, to give the years in which the science is studied, each of these columns being numbered 1, 2, 3, or 4, to indicate that the subject is studied in the 1st, 2nd, 3rd, or 4th year of high school. In some cases, it may be studied in two or more years. In this case the figure is entered in the unnumbered column, meaning that the year is not determined. Since the total number of schools studied is ninety-nine, and thus nearly one hundred, the totals given in the last column on the right may be regarded as percentages. Study of this table shows that about eighty-five per cent. offer physics and chemistry, about sixty-four per cent. offer botany, sixty-three per cent. offer hygiene and human physiology, fifty-eight per cent. offer biology, fifty-seven per cent. offer general science.

Comparing the figures in the first line, it is evident that in every section of the country (except the South Central), botany is given more frequently in the second year than in the first. The same is true of zoology. In the case of biology, the distribution is more even, for in the North Atlantic Division, biology is given as frequently in the first year as in the second, and it is also given in the third and fourth years. In the North Central Division, biology is also given as frequently in the first, as in the second year. In the other divisions, however, biology is given more frequently in the higher years than in the first year. It is to be noticed that in the North Atlantic Division, biology is given more frequently during the last three years than in the first year. This is different from the results obtained in 1910, where biology was given more frequently in the first year in the North Atlantic Division, though more frequently in the second or later years, in the rest of the country.

From the figures given in Figure 1, Table II is constructed. Here the sciences are separated according to years and the percentages of the total given. These results are compared to

the figures for 1910; also, percentage values found for 1910 are compared. These figures seem to show that more of the science work is done in the first year in 1919 than in 1910; the second and third years seem to have changed very little, though the number of courses given in the fourth year appears to have decreased slightly. On the whole, the distribution of sciences in the four years of work appears to be rather even.

TABLE II.
Comparison of Number of Science Courses in the Four Years of School Work.

	1st Year		2nd Year		3rd Year		4th Year		
	No.	%	No.	%	No.	%	No.	%	Total
1910	360	26.2	317	23.1	334	24.3	360	26.2	1371
1919	143	31.5	108	23.8	112	24.6	91	20	454

TABLE III.
Comparison of the Frequency of the Several Sciences in High School Work, in 1910 and 1919.

Yr.	Total	Biological Science		General Science		Physiography		Chemistry		Physics	
		No.	%	No.	%	No.	%	No.	%	No.	%
1910	1371	645	47	9	.7	171	12.4	263	19.1	283	20.6
1919	496	225	45.3	57	11.5	43	8.7	85	17.3	86	17.5

To see if any change is observable in the proportions of the various sciences, Table III is arranged, the figures being taken both for 1910 and 1919. Comparison of these figures shows that in 1910, 47 per cent of the total number of sciences were biological, while 1919, 45.3 per cent were biological, a slight decrease being shown. In 1910, .7 per cent of the total sciences was General Science, whereas in 1919, this has increased to 11.5 per cent. At the same time, physiography, which in 1910 was 12.4 per cent, has dropped to 8.7 per cent. In 1910 and in 1919 chemistry and physics occupy the same importance in the curriculum, with respect to one another. Though the biological sciences show a very slight change, and this is true also of chemistry and physics, the growth of general science appears to be very remarkable, increasing from .7 per cent to 11.5 per cent.

To find if any change in the proportion of the various biological sciences has occurred, the percentage values for 1910

and for 1919 were found. Table IV shows the number of courses in botany, zoology, physiology, and biology recorded among the schools studied in 1910 and also among those studied in 1919. Comparison of these percentage values shows that in every case except biology there has been a decrease in the number of courses given. Whether this change is due to the actual replacement of separate, distinct courses in botany and zoology by a unified course in biology or whether the half-year course in botany and half-year course in zoology have merely been combined and called biology, it is, of course, impossible to say.

TABLE IV.

Percentages of the Biological Sciences in 1910 and in 1919.

	1910		1919		
	Number	Percentage	Number	Percentage	Diff.
Botany	225	35.1	64	28.4	−6.7
Zoology	150	23.4	40	17.8	−5.6
Physiology and Hygiene	193	30.1	63	28.0	−2.1
Biology	73	11.3	58	25.7	+14.4

Taking the figures for 1919 from Table I, the percentages of the total number of botany courses, for example, are found for the first year, second year, third year and fourth year (see Table V). These percentages of the different sciences are compared with similar percentages found for 1910. It is evident that both botany, zoology and biology, are given less frequently in the first year, third year, and fourth year. There is, therefore, a tendency to place these three subjects in the second year of high school. Hygiene and human physiology appear to have increased in the first and third years. Comparing the totals of the biological sciences one finds that there is a decrease in the first and fourth years and a decided increase in the second year, and an inappreciable change in the third year. General science, instead of being entirely in the first year as in 1910, is shifted to some extent to the second year in 1919, although this change is slight. Physics seems to occur more frequently in the third year, but there appears to be no discernible change in the position of chemistry.

Owing to the more or less uncertainty of arrangement of the

Science	First Year			Second Year			Third Year			Fourth Year		
	1910	1919	Diff.	1910	1919	Diff.	1910	1919	Diff.	1910	1919	Diff.
Botany	33.7	28	−5.7	41.7	60	+18.3	11.5	8	−3.5	12.9	4	−8.9
Zoology	18	6.6	−11.4	56	73	+17	16	13	−3	10	6.6	−3.4
Biology	49.3	26	−23.3	31.5	42	+10.5	9.6	16	+6.4	9.6	14	+4.4
Total of Botany, Zoology and Biology	31.0	22.4	−8.6	44	55	+11	13.5	13	−.5	11.5	9	−2.5
Hygiene and Human Physiology	54.4	61	+6.6	17.6	15	−2.6	10.9	16.6	+5.7	17.1	7.4	−9.7
Total Biological Sciences	38	33.8	−4.2	36.6	44.2	+7.6	12.2	13.5	+1.3	13.3	9.8	−3.5
General Science	100	94.6	−5.4	0	5.4	+5.4	0			0		
Physiography	56.6	51.2	−5.4	29	25.6	−3.4	36	5.1	−30.9	10.2	18	+7.8
Physics	0	0	0	9.5	6.8	−2.7	56.3	65.7	+9.4	34.2	27.4	−6.8
Chemistry	0	0	0	3.2	3.0	−.2	37.9	38.2	+.3	58.8	58.8	0

TABLE V.

Comparison of Percentage Value of Sciences by Years in 1910 and in 1919.

various sciences in the high school curriculum, it was thought that perhaps a general expression of opinion on the best sequence of sciences would be of value. This question, therefore, was presented in the words, "What sequence of sciences, by years, would you suggest in organization of high school sciences?" Table VI is the tabulation of the answers to this question. The upper space shows each science, and under each are five columns, the first four for the four years of school; the fifth gives the total number. The body of the table is divided into two parts, the upper for the actual number, the lower for the percentage of the total.

No attempt has been made to find what percentage of the total number of answers offer botany, or zoology or physics, for example, in the curriculum, but rather to find in what year whatever subjects mentioned, should be placed. Evidently it is the opinion here that general science belongs, without question, in the first year, since in every case that general science is mentioned, it is placed in the first year. Botany, zoology and biology are grouped together, for convenience, and it appears that in seventy per cent. of the cases, these subjects are placed in the second year. There does not seem to be any great preference, in chemistry, between the third and fourth year, though the tendency is in favor of the latter. In physics, however, there is a preference of about twenty per cent. in favor of placing physics in the third year. In sixty per cent of the cases, physiography is placed in the first year. Human physiology shows the greatest distribution throughout the four years, though here also, about forty per cent. place it in the first year.

This table becomes more interesting when compared with Table V, which shows how the sciences are actually distributed now, in these schools, in 1919, and the distribution in other schools, in 1910. In the space, "Total of Botany, Zoology and Biology," the percentages for 1910 are compared with these for 1919, and it would appear from these figures that these three sciences are given less frequently in the first year, now than formerly, and are given more frequently in the second year now than heretofore. That there is a tendency for this to continue, is shown by comparing these figures representing the *actual* situation, with these representing the *desired* situation.

If the sciences were arranged as desired, in seventy per cent. of the cases botany, zoology and biology would be placed in the second year, whereas only 44 per cent. were in the second

	General Science					Biology or Botany or Zoology					Chemistry					Physics				
School Year	1	2	3	4	Total	1	2	3	4	Total	1	2	3	4	Total	1	2	3	4	Total
Number	55	0	0	0	55	11	55	5	7	78	0	4	35	38	77	0	9	42	27	78
Per Cent	100	0	0	0		14	70	6	9		0	5.2	45.4	49.3		0	11.5	53.8	34.6	

	Physiography					Human Physiography					Agriculture					Psychology				
School Year	1	2	3	4	Total	1	2	3	4	Total	1	2	3	4	Total	1	2	3	4	Total
Number	9	5	1	0	15	11	7	5	4	27		1	1		2				1	1
Per Cent	60	33.3	6.7	0		40.7	25.9	18.5	14.8			50	50						100	

TABLE VI.

Tabulation of Answers to Question, "What Sequence of Sciences by Years, Would You Suggest?"

year, in 1910, and only 55 per cent. are now, at this time (1919) in the second year, among the schools investigated. The situation with respect to chemistry and physics appears to be about as desired since chemistry is placed most frequently in the fourth year and physics in the third. In the case of human physiology, one might conclude that there is a desire to spread the courses in physiology throughout the four years, although it is placed more frequently in the first year than in any other.

A second question asked was, "What is your opinion of the introduction of General Science?" Of the seventy-seven answers to this question, forty-five or 58.4 per cent. consider it good, twenty-four or 31.1 per cent. consider it not good and eight or 10.4 per cent. are doubtful. (See Table VII.) The sentiment in favor of the introduction of General Science is, therefore, not overwhelming.

A third question, "What effect, if any, has the introduction of General or first year science, had upon the position of Biology?" has not shown such exact results, but the answers have been classified to some extent. (Table VIII.) The answers have been separated into three groups. The first group is where the effect has been favorable, and this group is subdivided into three divisions, first, where the interest has been increased, second, the number of students increased, or third, where it has been shifted to the second, third, or fourth year, as a result of the introduction of general science. The second group is where there has been no observable effect. The third group consists of those in which the effect has been unfavorable. This third group is subdivided into three smaller divisions, first, where the actual number of students has decreased; second, where the interest has been decreased; and third, where biology

TABLE VII.

Answers to Question, "What is your Opinion of the Introduction of General Science?"

Good	Not Good	Doubtful	Total
45	24	8	77
58.4%	31.1%	10.4%	

as a separate subject has actually been taken out of the curriculum and replaced by general science. It is interesting to see that roughly about one-third of the answers are unfavorable, one-third favorable, and one-third negative. Where the effect

is negative, it is, perhaps, legitimate to hazard a guess that biology had had its original place in the second, third or fourth year and general science has come into the first year to replace physiography or to share with physiography the place of a first year science and, therefore, there has been no effect upon biology. It is also interesting to note that in about eight per cent. (7.6%) of the cases, as a result of the introduction of general science, biology has actually been annihilated as a high school subject.

TABLE VIII.
"Effect of General Science Upon Biology."

	Favorable			No Effect
Total	Increased Interest	Increased Number of Students	Shifted Biology to 2d, 3d, or 4th Years	Total
24	6	8	10	22
36%	9.1%	12.1%	15.1%	33.3%
	Unfavorable			
Total	Decreased Students	Decreased Interest	Replaced Biology	Final Total
20	11	4	5	66
31%	16.6%	6.1%	7.6%	

Conclusion.

1. Among the more important findings in this piece of work is the very marked tendency toward placing biology in the second or higher school years, in the schools investigated.

2. The bulk of the hygiene work (54% in 1910, 61% in 1919) is done in the first year.

3. General science has increased from .7 per cent. of the total number of science courses in the schools studied in 1910, to 11.5 per cent of the total number of science courses among the schools studied in 1919.

4. Answers to the questionnaire concerning the effect of the introduction of general science upon biology show that about one-third think the effect bad, one-third observe no effect and a little more than one-third consider it favorable.