A COMPARATIVE STUDY OF THE BIOLOGY COURSES OF THE HIGH SCHOOLS AND TEACHERS COLLEGES OF THE UNITED STATES

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I. INTRODUCTION

The material presented in this thesis is a digest of the possibilities for teacher preparation in Biology in teachers colleges and the teaching practices that are in use in the high schools of the United States today. The writer hopes to reveal what is thought by many to be true; namely, that the teachers colleges are not presenting a type of training that will meet the problems of teaching for the high school teacher who, when he takes a position, must stick to the state high school course of study.

Mr. C. E. Montgomery in an article in School Science and Mathematics says: "The work given in the colleges and normal schools is so different from that in the high schools that each teacher must resort to his own ingenuity and secondary school literature for materials and methods."[1]

Although the work done by Montgomery, Richards, Hutson, Finley, and others has opened up a splendid and what may be a valuable field, the final word on actual conditions has not yet been said. The author does not claim in this thesis to add any material weight to their arguments, but he does

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[1]C. E. Montgomery, "Biology Teaching in Indiana High Schools," School Science and Mathematics, 16: 220-232, 1916.

wish to stimulate and materially aid in some further researches along this line. Any facts that are brought to light by this study that will prove the charge made in the opening statement may be valuable information for future organization and administration.

A careful study of the card catalogue of this college and of the Glenn and Walker's "Bibliography of Science Teaching in Secondary Schools"[2] failed to reveal that any study of this nature had been made. However, there are several topics dealing with one side or the other of the problem that have furnished some very useful materials. The names of these individuals with their school connections are as follows: Elliot R. Downing, University of Chicago; P. W. Hutson, University of Pittsburg; C. E. Montgomery, Northern Illinois State Teachers College; Jesse M. Shaver, Peabody College for Teachers; R. A. Millikan, University of Chicago; George E. Nichols, Yale University; Stratton D. Brooks, University of Illinois; I. C. H. Robinson, Normal School, Upper Montclair, New Jersey; E. R. Edwards, State High School Inspector, Jamestown, North Dakota; Oscar W. Richards, University of Oregon; and many others.

The materials used in compiling this treatise were of four types: (1) the questionnaires. These were of two types, one was forwarded to the Department of Science of the teach-

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[2]E. R. Glenn, and Josephine Walker, Bibliography of Science Teaching in Secondary Schools. U. S. Bureau of Education, Bulletin 13, 1925. P. 161.

ers colleges and one to the teachers of science in the high schools. Sixty-five questionnaires were mailed to teachers colleges in thirty states. Of this number fifty-three were returned fully or partially answered. Two hundred and sixty questionnaires were mailed to high schools in the same states. Of these, two hundred and twenty were returned fully or partially answered; (2) letters were mailed to the registrars of the teachers colleges asking for a syllabus of the science courses; (3) letters were sent to the State Departments of Public Instruction asking for the state courses of study for high school biology; (4) a study was made of the college bulletins or catalogues of the fifty-three that returned the questionnaires. In some few cases, a follow-up questionnaire was necessary to get the material wanted. Later, when checking over the material, some of the answers were so conflicting and sometimes so unreasonable that letters were sent asking that certain answers be clarified. From these four sources, data were taken to support the argument of the problem stated.

The discussion of the problem has been divided into two parts. The first part will deal with the college courses and their possibilities, and the second part will deal with the high school courses and methods.

II. COLLEGE COURSES AND THEIR POSSIBILITIES

The fifty-three schools that were training students for the teaching profession were divided into four groups as follows:

State Normal Schools	6
State Teachers Colleges	37
Private or Endowed Teachers Colleges	9
Normal Universities	1

A careful checking of the catalogues, bulletins, and circulars of information of the colleges revealed a somewhat deplorable condition as to their supporting and maintaining a Biological Department. In eighteen of these colleges or almost thirty-four per cent no biology department was organized, whereas only thirty-four, or sixty-four per cent, had such a department. Many in the latter group could hardly be called Biological Departments because the number of credits possible in the field of Natural Sciences was few and oftimes limited to particular branches. From a study made of the methods and objects in biology courses, Mr. Barrows found that out of 100 leading colleges and universities, more than twenty-five per cent of the institutions reporting teaching all the biological groups of sciences were emphasizing nothing.[3] This statement seems to be true yet today, for a study of the school circulars

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[3]Franklin W. Barrows, "Biology in American Colleges--Its Methods and Objects." School Science and Mathematics, 2: 19-21, 82-89, 1902.

revealed a greater emphasis was being placed upon botany than any other branch. "Of the three biological sciences (botany, physiology, and zoology) early recognized as secondary school subjects, botany has been and still is the leading one."[4]

Some schools, while not maintaining a special department for biology, were offering a few courses in this science. While other schools were supporting combined departments such as, science and mathematics, physical science and biology, biology and social studies, and home economics and biology. These combinations were treating biology purely from the standpoint of its influence upon human life.

There is some evidence to support the contention that state institutions are more often engrossed in real estate expansion than they are in keeping up to date with the departmental work and organization. As an example, one large and very fine state teachers college boasts of a campus of a hundred and thirty acres of land with buildings and equipment valued at a million dollars and an annual enrollment of fifteen hundred pupils, yet this school has no biology department, grants no degrees in science, but does permit a major in biology with the completion of forty-eight hours of work.

Another extreme example comes from one of the wealthiest

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[4]Charles W. Finley, "Biology in Secondary Schools and the Training of Biology Teachers." Teacher College Publication 2: 199-126.

agricultural states in the union. This State Normal School has no biological department and lists no biological subjects in the circular of information about the courses offered. It would seem that a school so situated and surrounded with such wonderful opportunities to give the young men and young women some useful and practical training was missing a fine opportunity to be of the greatest help to the citizens who were supporting it.

However, a few schools need to be highly commended for their excellent organization and the broad field of studies offering a wonderful opportunity for students to receive training in biology.

A. Degrees

A college's popularity depends upon its ability to give the student what he wants and as much as he wants when he wants it. Of course the type of work is somewhat controlled by state law, but prospective teachers must prepare for the type of teaching they expect to do. However, some of the things students must consider when choosing a college in which to get their higher learning and preparation for life are: Kind and number of degrees, major fields, and the opportunity to get the required amount of work for a license. Before a college is granted the privilege of conferring a degree it must meet the requirements of the association of colleges and universities. It is a fair measuring stick, therefore, to say that a college may be judged by the number

TABLE I

DEGREES OFFERED AND THE NUMBER OF COLLEGES CONFERRING EACH DEGREE

Degrees Offered	B. S. in Ed.	B. S.	M. S.	A. B.	A. M.	B. of Ed.	No degree in Science
Colleges Represented	16	18	3	19	2	2	18

and type of degrees it confers upon its graduates.

From the questionnaires which were checked with the school catalogues, Table I was derived.

The first examination of the above table might give one the impression that a degree in science is the outstanding favorite with the teachers colleges. The figures indicate that out of the fifty-three colleges examined thirty-four were conferring the bachelor of science degree. However, this is not quite the state of affairs. The degree requirements for the Bachelor of Science in Education are identical with those of the Bachelor of Arts degree excepting the major field must be in science. The required number of hours for graduation is the same and the required number of hours for a major is the same. Most of the work done for this degree must be done in the field of education and the subject matter that the student expects to present to high school girls and boys is pushed into the background. Many of the states have made the teaching of biology mandatory, but at

the same time have not required the teachers colleges to permit the student teacher to devote his major portion of time to the field of biology. This situation is absurd. Of course, with permission, which is often not granted, the student may choose his second major or minor in the same field. An approximate number of semester hours for graduation is about one hundred and twenty-five. An approximate number of semester hours for a major is about thirty. It is to be seen then that the per cent of total time required for graduation that may be spent in the field of biology is only about twenty-six per cent of the total number of hours of preparation. In an article entitled, "The Demand for Science Teachers," Mr. Brooks says: "There is no subject which suffers more from lack of adequate preparation on the part of the teacher than does science."[5] This surely is not all the fault of the teacher. Much of the blame must rest with the school that trained him. C. T. Hodge makes a plea that the college "prepare its student to teach by modifying present biological courses or by putting in coordinate courses specially designed to fit teachers for high school."[6] This statement strongly suggests that the biological courses are not adapted to fit teachers for the high school work. Again we hear an echo in the School Review of April, 1908. Balliett says: "My contention is that graduate instruction in our universities does nothing

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[5]Stratton D. Brooks, "The Demand for Science Teachers," School Science and Mathematics, 1: 53-55, 1910.

[6]C. T. Hodge, "College Biology in Relation to the Training of Teachers." Nature Study Review, 4: 193-196, 1908.

to fit a teacher to teach either science or mathematics in a vital way in secondary schools. It may even be possible that the highly specialized training of the graduate school, to a certain extent, unfits the student to do this sort of teaching. However that may be, I state a well known fact when I say that not one in fifty of the men and women who take the Doctor's degree in science or mathematics has the least conception of the problem before him when he begins teaching in the secondary school."[7]

While Mr. Balliett is speaking only of the graduate school, there is no reason why this statement cannot be true in a lesser degree in the undergraduate school. If one might venture to draw a conclusion from the above quotations, it would be that the teachers colleges with their methods, at least of a few years ago, were making pupils unfit to become teachers. What the result of this process has been no one has taken the trouble to find out. No doubt this condition has been modified to some extent in the post war period.

A second glance at the table will reveal how little the opportunities are for teachers to return to their Alma Mater and work in the graduate field. The education of a teacher is a never ending process. Teachers must keep abreast of the times. To do this they must return occasionally to school. Nothing or little is to be gained by rehashing the under-

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[7]T. M. Balliett, "The Influence of The Present Methods of Graduate Instruction on Teaching in Secondary Schools." The School Review, 16: 217-225.

graduate work. They need new fields, broader fields or fields that will challenge a more experienced mind. The above table shows how few are the chances for this advanced education in the teachers colleges. Only three of the teachers colleges are permitting advanced work leading to the Master of Science degree and only two permitting advanced work leading to the Master of Arts degree. Approximately five per cent and three per cent respectively. One of two things seems to suggest the probable reason. Either the higher institutions feel that their rights are being enfringed upon and they are exerting their influence against the teachers colleges or else the association of colleges and universities feel that the quality of the work of the teachers colleges is not high enough. However bad that may seem, yet it is not so deplorable as the fact that eighteen of these schools or about thirty-four per cent do not give any degree whatsoever in science.

Table II will show the states and the number of teachers colleges in each that are not giving a science degree.

A degree in itself means little, but the amount of preparation for which it stands mean much. The condition as illustrated by these eighteen schools is a fair measure of what perhaps exists in the United States in general. What may be brought to light in the field of science may hint of existing conditions in other lines of departmental work.

TABLE II

STATES AND THE NUMBER OF COLLEGES IN EACH THAT ARE NOT GIVING DEGREES

States not giving degrees	No. of colleges in states
Illinois	3
California	3
Colorado	2
Arizona	2
South Dakota	1
North Dakota	1
Minnesota	1
New York	1
Missouri	1
North Carolina	1
Louisiana	1
West Virginia	1

TABLE III

MAJOR AND MINOR REQUIREMENTS IN BIOLOGY IN TEACHERS COLLEGES

Range of Semester Hours	Number of Colleges Requiring a Major	Number of Colleges Requiring a Minor
1 - 9	2	3
10 - 19	4	31
20-29	22	6
30 - 39	19	0
40 - 49	3	0
none	2	12

B. Major and Minor Requirements

Jesse M. Shaver says, "There is no general agreement among teachers colleges as to the character and amount of biology which should be offered."[8] This statement is somewhat borne out by the facts shown in Table III compiled from the questionnaires and college catalogues.

With groups 1, 2, 3, and 4, range 1 to 39, a total of 47 schools are represented. This means that more than 90 per cent of the colleges represented require less than 40 semester hours of work for a degree in science. The other 9.6 per cent is divided between schools giving more than 40 semester hours of work and the two having no major whatsoever in science. Of this larger group of 47 colleges, 59.6 per cent are requiring less than 30 semester hours of work and 40.4 per cent of the group are requiring between 30 and 40 semester hours of work. Of the remaining, 8.5 per cent between 20 and 29 semester hours of work and 4.2 per cent are requiring less than 10 semester hours of work. Of the total group represented above the greater number, the 41 requiring 20 to 39 semester hours of work, are giving less than 40 hours of work for a major in science. This latter group represents 78.9 per cent of the total number of colleges in question. Since this group is more than three-fourths of all the schools considered it is a safe assumption to say that one's chance for doing special work

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[8]Jesse M. Shaver, "The Preparation of Teachers for High School Biology." School Science and Mathematics, 2: 220-223, 1903.

in the field of biology is materially limited. How then could a degree, the Bachelor of Science in Education, be very valuable to a teacher of biology in the high school?

A statement has been previously made that it was possible, with permission, which is often not granted, to choose a second major or a minor in the same field. An examination of the above table should convince one of the meager possibilities in that direction.

As an example of the conditions found in this part of the study, the writer will quote from a statement typed on the back of one of the questionnaires. It says: "Departments in an administrative sense are unknown to us. It is therefore impossible to answer your questionnaire in terms you stipulate. We give no degrees in science, know nothing of majors in departments, require work for certain groups of students, although others may elect some of such work."[9] In a letter accompanying the questionnaire from Marshall College, Mr. Utterback says, "In teachers college we do not consider majors and minors in biology for teaching in the secondary schools."[10]

If biology is taught, and it most certainly is a very popular subject in some states, why then, are not students allowed to prepare themselves on an equal basis with teachers in other fields? Is it because biology is still frowned

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[9]Questionnaire from State Teachers College, Winona, Minn.

[10]W. I. Utterback, Marshall College, Huntington, West Virginia.

upon by the old and long established departments or is it because some individuals do not as yet realize its true worth and are holding it back subservient to the old and long established curricular subjects?

It does not seem likely and under the conditions stated above that it is possible for teachers of biology to become thoroughly grounded in their chosen field.

"The process of learning in school should not be different from that out of school--the greatest problem that confronts the schools is the lack of intimate relationship between the work of the school and the work of the world--school work needs to be real instead of artificial--there is no difference between education for research and education for life."[11] What Mr. Woodhall has said is not new to us today, but it is worth bearing in mind when college courses are being organized to train young men and women to be the leaders of tomorrow. It is not uncommon to hear teachers of science, particularly of biology, to speak of the lack of sequence in their college work. It was often a case of floundering around getting a little botany, a little zoology, and a little physiology, or spending most of the time with that subject they liked best. There was no analyzing the needs and experiences of the children of the community in which they expected to teach. There was no attempt to adapt their training to fit the needs of the community. In

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[11]John F. Woodhall, "Science Teaching by Projects," School Science and Mathematics, 15: 225-232, 1915.

most cases there was little or no conception as to how little or how much of their knowledge was to be presented to the pupils of the high school biology classes. Only by their own experience with the method of trial and error and resorting to secondary school literature were they able to become successful teachers.

Mr. Balliett says, "It would not vitiate, much less contaminate, as some persons imagine, the teaching of pure science and pure mathematics in our graduate schools, if some considerable emphasis were laid incidentally upon their application, at least in the training of teachers for secondary schools." Continuing he says, "The highly specialized training of the best graduate schools seems to make it difficult for the young teacher to view his work from the standpoint of his pupils rather than from that of his subject."[12] Here again we see left in the discard those things that would be most useful to the teacher; namely, what to teach and how to teach it.

On the questionnaires sent to the teachers colleges was a question purported to bring out the methods most used in training students for the teaching profession. The question asked where emphasis was placed in the teaching method. Four methods were mentioned with available space for additional ones. The four named were as follows: subject matter,

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[12]Thomas M. Balliett, "The Influence of The Present Methods of Graduate Instruction of The Teaching in Secondary Schools." The School Review, 16: 217-225, April, 1908.

TABLE IV

COMBINATIONS OF METHODS USED

Emphasis	No. of Colleges
Subject Matter	3
Subject Matter Laboratory Technique	10
Subject Matter Field Work	1
Subject Matter Methods of Teaching	6
Subject Matter Laboratory Technique Field Work	9
Subject Matter Field Work Methods of Teaching	6
Subject Matter Laboratory Technique Methods of Teaching	3
Subject Matter Laboratory Technique Field Work Methods of Teaching	7
Laboratory Technique	10
Laboratory Technique Field Work	1
Laboratory Technique Field Work Methods of Teaching	1
Total	48
Omitting to answer	3
Others	2
Total	53

laboratory technique, field work, and methods of teaching. The answers obtained to this question were widely distributed with many combinations occuring. Table IV shows the results.

So widely distributed were the methods used that it is difficult to draw conclusions. The old custom of getting the subject matter from the text and then go into the laboratory and see if the author told the truth, still seems to prevail. Those schools that were making use of all methods come nearest to our modern idea of teacher preparation. However, a few colleges are still sticking to the old idea "know your subject" and the rest (teaching) will follow as the night does the day. It is no doubt true, that a great many of the college professors and doctors have never taught a high school class in all their teaching careers. How could they then, possibly be familiar with the work of the high school? Luckey says, "Scholarship alone is not sufficient no matter how thorough and extended it may have been. There must be, in addition, the teaching instinct and a knowledge and appreciation of the educational processes and laws of mental growth."[13]

A conclusion best suited for this discussion of teaching methods is well expressed by Balliett in the words, "I suggest that the most important remedy would be to oblige every student in a graduate school who wishes to teach in

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[13]G. W. A. Luckey, Proceedings of National Education Association, 1907. Pp. 587-592.

a secondary school, or in a college, to study education both as a science and as an art, and make himself familiar with the best methods of teaching the subject which he is fitting himself to teach."[14]

C. Licenses in Science

Teaching licenses in the field of science are somewhat vague and undefined. The word science, as usually interpreted, means any one or all of the science courses or subjects taught in the secondary schools. Botany, zoology, physiology, biology, chemistry, and physics usually make up the list of high school science courses. In nearly all schools of accredited standing a few of these subjects are required, but in most cases the great majority of them fall into the field of electives. This condition may account, in part, for states not issuing special license for science teaching. However, in some of the larger school systems where the work is departmentalized, the state department of education requires the teacher to have a license in the science taught. Such license are based upon the number of credit hours of work the teacher has done in the field in which the license is to be granted. Still other states permit graduates from the colleges with the minimum required hours in science to teach any of the subjects listed above. In most cases these graduates are required by

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[14]Thomas M. Balliett, op. cit.

the state department to major in their chosen field. In the fifty-three colleges studied the number of semester hours required to procure a secondary teaching license in science varied from less than ten to more than sixty. Fifteen of these schools or 28.3 per cent stated that their respective states were not issuing a secondary license in science. Ten questionnaires omitted the answer to this question so that of the remaining twenty-eight states 32 per cent of them were requiring between ten and twenty semester hours of work. The remaining 68 per cent is distributed over a field ranging up to more than sixty semester hours of work. Table V will show the distribution of these requirements.

It would seem from Table V that the requirements are not sufficient. License to teach a special science is too easily obtained. This may account for some of the criticisms heaped upon the science department. For example, "The teachers themselves are largely to blame for the criticism heaped on the subject (biology). Their lack of sufficient preparation and consequent poor pedagogy, and their failure to see and appreciate the needs of the community and to adapt their courses thereto, have caused such criticism."[15]

The teachers colleges can hardly expect the student to visualize or foresee the dangers ahead of him if he fails

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[15]A. M. Holmquist, "The Biological Sciences in The Minnesota High Schools." School Science and Mathematics, 22: 166-174, 1922.

TABLE V

NUMBER OF SEMESTER HOURS REQUIRED TO SECURE A SECONDARY TEACHING LICENSE IN SCIENCE

Semester Hours Required for License	Colleges Represented
Less than 10 hours	1
10 - 19 hours	9
20 - 29 hours	5
30 - 39 hours	0
40 - 49 hours	1
50 - 59 hours	0
60 - 69 hours	1
Graduates with Major	9
Other Information	
Not giving secondary license	15
States making no specification for subjects taught	1
Omitting answers	10
Other combinations	1
Total	53

Note: Those schools requiring more than a hundred hours, either term or semester, were counted as giving degrees.

Those answering "none" were counted as not giving a license.

to prepare properly. The colleges must, in cooperation with the state departments, require more preparation for such licenses if such criticisms are to be avoided.

D. Permits to Teach

Are undergraduates given permits to teach? In some cases yes, but in the great majority of cases, no. Indiana formerly had such a law. The Indiana State Teachers College, at the completion of twelve weeks of work of a satisfactory nature, gave to the student an "A" certificate, which entitled him to a twelve months license in the common branches when and if he passed a state examination in those subjects. At the completion of twenty-four weeks of successful work the student was given a "B" certificate which entitled him to a license for two years.

This law has since been modified. In the Indiana State Normal School Bulletin is the following statement: "The following licenses are issued to students who have completed two years of work above graduation from a commissioned high school or its equivalency: (a) Rural school teachers license, first grade, (b) Primary teachers license, first grade, (c) Intermediate-grammar grade teachers license, (d) Special elementary school teachers license."[16] All first grade teachers licenses are valid for five years, renewal thereafter for life on presentation of evidence of three years

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[16] Indiana State Normal School Bulletin, Vol. 4, No. 5, July 1911. P. 24.

of successful experience and professional spirit. In answer to the question, are undergraduates given permits to teach, ten colleges replied in the affirmative and thirty-three replied in the negative, five said practice teaching under supervision, and five omitted the answer. Of the forty-eight answers nearly 69 per cent were not issuing such permits. There were three times as many schools answered in the negative as there were in the affirmative. The difference between the two seem great yet it is not as great as it should be. Practice teaching has its place as it intends to give the student some knowledge and contact with real classroom problems, but to issue permits to students to go out and teach with only one or even two years of training, most of which has not been in a classroom full of pupils, is infringing upon the right of the tax payer and doing an injustice to the teacher and the pupils. Teaching is quite a different thing from the theory of teaching. Again it seems fitting to say, the standards should be raised and the students given more real school room practice and study and not so much theory.

E. Syllabi

Requests were made of each of the fifty-three teachers colleges for syllabi of their biology courses. Thirty-three responded. Thirty of the thirty-three had no syllabi. One refused to send a syllabus because of the objection of the head of the department. One sent a syllabus and one

TABLE VI

SUMMARY OF INFORMATION CONCERNING
COLLEGE SYLLABI

Information	Colleges represented	Per cent having no syllabi	Per cent having syllabi	Total per cent
No syllabi	11	33.3		90.7
Sent other material	19	57.4		
Refused syllabi	1		3.3	
Sent syllabi	1		3.3	9.9
Publication exhausted	1		3.3	

stated their supply was exhausted. Of the thirty schools having no syllabi, eleven stated that they had no prepared syllabi, but the other nineteen sent either catalogues, pamphlets, letters or leaflets showing the biology courses. Table VI shows results in brief.

Group one and group two are evidently in the same class or else group two would not have sent materials. The two groups, one and two, constitute over 90 per cent of the total number. It seems a safe assumption to make when one says that, generally speaking, teachers colleges do not have printed syllabi of their courses. Does this in a measure account for the conditions in the high schools? Do not the secondary teachers copy, to some extent, methods and materials from the colleges? No doubt about it. "A resultant fault in high school teaching is the often deplored perpet-

uation of the miniatures of college courses, similar to them in approach and method, but attenuated in content and interest."[17]

F. Summary

The biology departments of teachers colleges are not well organized. In many cases these departments were combined with unrelated subjects. The degrees conferred were in most cases not purely degrees in science because the requirements specified that more time be spent in other departments and not enough time in biology to really warrant a science degree. In the teaching of science little stress is laid upon the problems that will face the pupils when they become high school teachers. Licenses to teach biology are in most cases too easily obtained. The pupils are not required to be thoroughly grounded in subject matter and problems of teaching. Over 90 per cent of the teachers colleges do not have a syllabus of their biology courses. Nearly all departments have methods courses except departments in biology. Of thirty-three college year books examined, 67 per cent had no courses in the teaching of biology compared to 30.3 per cent that had such courses. Five colleges were giving courses in collecting, preserving, and preparing materials for class use, but these could hardly be called courses in methods of teaching.

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[17] I. H. C. Robinson, "Training of Science Teachers." National Educational Association, Addresses and Proceedings. Pp. 730-731, 1916.

III. HIGH SCHOOL COURSES AND METHODS

The two hundred and twenty high schools that were considered in this study varied in size from an enrollment of one hundred students to one of over six thousand students. This wide range in size according to enrollment permitted a more accurate account of actual conditions than would have been possible otherwise. These high schools were located in the same thirty states as were the teachers colleges.

Biology as a subject for high school students is neither the newest nor the oldest. Its popularity and its appeal to students, when in charge of a capable teacher, is unquestioned. The personal contact between the pupil and his environment is ever a source of wonder and enjoyment.

A previous reference pointed out that a fault in high school teaching was due to the copying of miniature college courses and methods. "The course in biology should consider the learner's point of view and functional needs; it should not be a preparation for a biological career."[18] This statement by Mr. Nelson is a fine guiding principle when organizing any high school science course. A large per cent of high school pupils never enter college and those that do are not always decided as to what college course they wish to pursue. Therefore, his high school biology should help in his mental growth and development the same as any other

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[18]George E. Nelson, "The Introductory Biological Sciences in the Traditional Liberal Arts Colleges." Teachers College Publication, Columbia University.

subject and give to him, in addition, that knowledge of life which will be most useful.

In the group of two hundred and twenty high schools studied 72.3 per cent were teaching biology. One hundred and thirty, or approximately 60 per cent were teaching only biology while twenty-nine or about 13 per cent were teaching biology with other branches. Fifty-one schools or 23 per cent were teaching other branches instead of biology and ten schools, or 4.5 per cent, were not offering biology at all. The 23 per cent that were teaching other branches were divided between nature study, botany, zoology, physiology and hygiene or health. The four subjects; botany, zoology, physiology, and hygiene ran a very close race. They were in order as stated: 52, 34, 44, and 39. Of the entire group only one was listed as doubtful. This school, Provincetown high school, Provincetown, Massachusetts, said that they did not have any of these subjects as such. Nature Study must not be a popular high school course as only three schools listed it as being offered to the student body. The distribution of the various subjects is shown in Table VII.

Table VII shows that approximately 73 per cent of the high schools were teaching biology and of the remaining 27 per cent, about 22.5 per cent were teaching individual biological subjects. So that of the entire group of two hundred and twenty high schools approximately 95.8 per cent were either teaching biology or some subject from the

TABLE VII

COURSES OFFERED BY HIGH SCHOOLS

Subject Offered	No. of Schools	Per cent
Nature Study	3	
Botany	53	
Zoology	34	
Physiology	44	
Hygiene or Health	39	
Biology	159	
No Biology	10	
Doubtful	1	
Note: Combined courses were counted as biology.		
Biology only	130	60
Biology with other branches	29	13
Other branches instead of biology	51	23
Not offering biology	10	4.5
Total	220	100

biological group. This looks as if the secondary schools were using a large number of biology teachers. It would seem that this number would warrant thorough methods courses in biology.

TABLE VIII

CREDIT REQUIREMENTS

Courses offered	No. of schools in each group	Range of credits	Group average
Nature Study	1	1	1.
Botany	23	¼ to 2	.97-
Zoology	20	¼ to 2	.81
Physiology	17	¼ to 1	.81-
Hygiene or Health	24	¼ to 3	1.06
Biology	60	1 to 10	1.65

Note: The ¼ credit was derived by dividing a credit that was given for work in four fields. A few high school biology teachers were giving one credit in science for work divided between four subjects. The questions in the writer's mind was whether these subjects were really a course in biology.

The credits required for graduation in these subjects varied from one-fourth credit to ten credits. The highest standard for any of the subjects listed above was found in biology. In this subject the highest standard was a requirement of ten credits and the lowest one credit. This gave an average for the sixty schools of 1.65 credits. Sixty-four schools did not require a credit for graduation in any of the sciences listed. Of the total group twenty-six of the answers to this question were omitted. The

summary of these requirements is shown in Table VIII.

The total number seems to be greater than the original group, but this is explained by the fact that those schools requiring biology were also offering, in addition, other subjects. Quite often the subjects were physiology and hygiene. One hundred and one schools or about 64 per cent stated that with them biology was an elective course. This is rather a large number when compared with the sixty that required biology. Compare the possibilities in this course with those of English or mathematics. The English courses are required in the first three years of high school training in the state of Indiana. Biology is not taught in all school systems in Indiana, but when and where it is taught one year's work is the alloted time given it.

Why is there so much difference?

Teaching biology to high school students, usually freshmen, is a stupendous task as the writer well knows. The strict economy program by the school boards for the last few years has greatly added to the burden. The reduction of the teaching force has increased the teaching load to such an extent in many schools that creative work on the part of the pupil has been curbed. The writer met nearly two hundred freshmen biology students daily during the fall semester of 1932. The task of finding material with which to conduct laboratory work for such a group was beyond human endeavor, especially when there was no money with which to buy such material. Under such conditions the

TABLE IX

METHODS OF PRESENTATION

Method of presentation	No. of Schools
Study-recitation	102
Laboratory	114
Lecture	38
Project	33
Field Work	46
Combination of all methods	81
Directed study--mimeograph work-sheet	1

teacher resorts to the study-recitation method, the poorest way to teach a science. "I believe that the teaching of biology, which in its broadest sense, is one of the most important studies a secondary school student may take, needs to be adjusted to the great advances that have been made in recent years, or else lose its place in the secondary school curriculum; and that the discredit that has come to it as a high school study is due largely to the somewhat dillentante superficial way in which it has been given."[19] Mr. Abbott is right, no doubt, but the organization often defeats the purpose of a biology class. According to the information

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[19]T. F. Abbott, "The Teaching of Biology in The Secondary Schools." School Science and Mathematics, 8: 191-198.

TABLE X

FREQUENCY OF USE OF VARIOUS METHODS

Type of plan	No. of Schools
Study-Recitation	3
Study-Recitation and Laboratory	29
Laboratory and Lecture	5
Study-Recitation and Lecture	2
Laboratory and Project	1
Project and Field Work	1

gained from the questionnaires the study-recitation method is still a headliner. The laboratory method has a slight preference. In answer to the question "What method of presentation do you use?" Table IX was derived.

Little time is given to either lecture, project, or field work. In a large number of cases the high school teachers were making use of more than one method. This seems a better plan yet it does not speak of good organization. Table X shows the frequencies of the various double method plans.

Here again we see the study-recitation plan has the greatest frequency. This method does not give the pupil a chance to explore and find out things for himself. He has no opportunity to develop initiative. All impulses of natural curiosity are curbed. The teacher must be interested

in the teaching of biology in a bigger way than that of merely presenting facts and figures to the pupils. Dan O. Baird says, "There must be a keen interest in the broader problems of biology teaching--an interest in the subject for its functional value in human society."[20] Students of the high schools, especially freshmen, are not mentally and physically well enough developed to study biology from a strictly scientific point of view. Hunter says, "We find that contrary to the methods advocated for the secondary schools, the method of science in its pure inductive form is not so well fitted to beginning student's use as we used to believe."[21]

Downing says, "Biology should be chiefly concerned with behavior and environmental relationships."[22]

In other words these men have said that biology should not be taught purely from a scientific point of view, but should be used to guide the pupil and help him to form the proper social adjustments to his environment.

"While a high school course does not and cannot prepare for research, if it fails to lead the student to further study in the same line it fails in doing part of what should

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[20]Dan O. Baird, "A Study of Biology Notebook Wook in New York State," Teachers College Publication, Columbia University. No. 400, 1929.

[21]George W. Hunter, "The Problem in Method in Elementary Biology," School Science and Mathematics, 27: 594-605, 1927.

[22]Elliott R. Downing, "Some Radical Departures in The Teaching of Biology," School Science and Mathematics, 24: 743-745, 1924.

be its object."[23]

In the table showing the number of schools using a combination of two methods, the study-recitation and laboratory method seems to be most popular with the high school teachers. However, a number of plans have been tried out by college graduate students with high school students and they all agree that the lecture-demonstration method of teaching biology is the most satisfactory. The following quotations testify to the above statement.

"As far as the acquisition of knowledge is concerned, the lecture-demonstration method is more efficient than the laboratory method of instruction, and much more economical of time and material."[24]

"The lecture-demonstration people made a final average, upon all the experiments, that was 5 per cent higher than the final average of those doing individual laboratory work. In practically every case, time and trouble can be saved by the use of the lecture demonstration method. From the point of view of economy of time, the results favor the lecture-demonstration method."[25]

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[23]G. H. Bretnall, "Shall The Course in Biology in The Secondary School Consist of One-half Year of Zoology and One-half Year of Botany, or a Full Year of Either Subject," School Science and Mathematics, 6: 578-583, 1901.

[24]Elliott R. Downing, op. cit.

[25]Harry A. Cunningham, "Under What Conditions in High School Science is Individual Laboratory Work Preferable, and When Does the Lecture-Demonstration Method Give Better Results." The Proceedings of The High School Conference of Nov. 18, 1920. University of Illinois, 1920.

No matter what these researches by graduate students have revealed about the teaching of biology the fact still remains, as evidence has shown, that the lecture-demonstration method is little used by high school teachers. No doubt some use is made of the laboratory in every school that is financially able to equip one, but a great number of our present high school teachers are still using the old method of first having the pupils study in the book, assisted by outline or questions prepared by the teacher, and then having the work tested by seeing how well they can discuss the points in the assignment.

One of the newest methods of teaching in the high school is the project method. Under the direction of the teacher a problem may be selected by the individual pupil or by a group of pupils and may be worked out by the individual pupil or by the group under the direction of the teacher or independently. These problems are selected from a list that has been previously worked out by the teacher. Some very fine work has been obtained by this method. Referring to Table IX, it will be seen that this method is used by 15 per cent of the group only. As this type of work places a large amount of responsibility upon the shoulders of the pupil, it takes a very skillful teacher to prevent slipshod work being done.

Approximately 37 per cent of the schools were making use of all the methods combined. Perhaps most of our high schools, equipped and organized as they are, can well make use of all the methods, as this gives the teacher the opportunity to adapt the best method to the situation at hand.

It has been previously stated that biology should not be taught from a purely scientific point of view. The laboratory method is just that method of approach. Most details of anatomical structure and functions are too complex for the comprehension of freshmen high school pupils. Of course their curosity is excited and they want to see things with their own eyes much as most people want to see the mysterious, but the details accompanying this type of work soon have the immature mind in a tangled mass of mysterious and complex phenomena from which, in most cases, he is not able to emerge. No doubt, the desire of every high school science teacher to use the laboratory method is a result that has carried over from his college training. Of these two hundred twenty high schools in question one hundred and fourteen or 51.8 per cent were making use of the laboratory method of teaching. In his "Psychology of High School Subjects" Charles H. Judd says, "The laboratory situation (for students) is usually too complex for the immature student to master if left to his own devices."[26]

From E. R. Edwards, who was state high school inspector in 1917 at Jamestown, North Dakota, comes some very pointed criticism. He says, "Laboratory work in science in high school has small value as often conducted at present--present laboratory methods often penalize ingenuity--our laboratory tactics are often similar to those employed in fattening a

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[26]Charles H. Judd, "Psychology of High School Subjects. Ginn and Company, 1915. Pp. 303.

goose. We cage our student and ask him to do no constructive thinking."[27]

The discussion of the teaching methods employed by high school biology teachers has revealed two existing conditions. First, that the methods employed in the teaching of high school biology are many and varied. Most emphasis is placed upon the study-recitation method. Secondly, research has shown that the best results are obtained by the lecture-demonstration method and that this method is used but little by the high school teacher.

A question was placed in the high school questionnaire which was intended to bring out the fact that the teacher, in many cases, was not making use of that method which appealed most to the students. The question was, "Which method of presentation seems to appeal most to the pupils?" In checking over the answers to this question the writer was confronted with the probability that the answer to this question had been determined by the teacher's practice rather the pupils' responses. Table XI shows a summary of the answers received.

Table IX shows that one hundred and fourteen schools were making use of the laboratory method in science teaching. In Table XI one hundred and twenty-six teachers said that the pupils preferred the laboratory method. The two numbers very nearly coincide. As previously stated most pupils

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[27]E. R. Edwards, "The Training of High School Teachers." National Educational Association, Addresses and Proceedings, 2: 537-540, 1917.

TABLE XI

PUPILS' PREFERENCE OF METHOD

Method	No. of Schools
Study-Recitation	29
Laboratory	126
Lecture	13
Project	42
Field Work	72
Combination of all methods	6
No difference noticed	5

enjoy laboratory work, but are not mentally equipped to do such work in its strictest sense. Jones says, "It is a serious question whether or not the average student is by temperament or training fitted to profit materially in the average laboratory course."[28] Second in choice was field work. Field trips are always welcomed by the pupils, but not always for their educational value. Field trips, when skillfully handled, are very profitable in nature study, but in many cases the pupil considers it an excursion or else welcomes it as an opportunity to escape from the classroom. More than half of the schools under consideration

[28]E. M. Jones, "Laboratory Versus Recitation." School Science and Mathematics, 23: 749-759, 1923.

TABLE XII

NUMBER OF FIELD TRIPS TAKEN BY SCHOOLS

Number of Trips	Number of Schools
1 - 3	71
4 - 6	54
7 - 9	9
10 - 12	14
13 - 15	2
16 - 18	0
19 - 21	2
22 - 24	0
25 - 27	1
28 - 30	0
Total	153

were making six or less field trips per semester. Fewer schools participated in a great number of field trips than those who conducted many such trips. The approximate number of field trips per semester is shown in Table XII.

A successful field trip depends entirely upon the skill of the teacher conducting this type of work. Much good, or much loss of time, or even harm may come from them. They are profitable, but difficult to conduct. Ralph K. Watkins says, "Field trips are profitable if made for the purpose of

attaining some definite objective. Field trips are often desirable, but should be taken only when the need for such work grows out of the problem in hand. The teacher must know the territory to be studied. The object of the trip should be made clear to the student."[29] Sometimes a locality is not suitable for this type of work. This may necessitate the teacher making the field trips alone to gather material. One teacher in the state of Arizona said that no field trips were taken due to the fact that they were situated in the midst of a desert with pupils coming from forty to forty-five miles in each direction. Also that pupils were instructed to bring to class certain specimens that the teacher knew they could get. This method seemed to work very nicely. About 15 per cent of the teachers were not making field trips at all. That is an easy way out of a very difficult job.

The time spent in the high school science classes is usually divided between three types of activities: study, recitation, and laboratory. Not all schools make such a division of time for some combine the different types of activities into one or two. The three types will be considered separately and then comparisons made and conclusions drawn. In calculating the division of time for each type of activity, the length of the periods, the number of schools under each division of time, and the number of times per week that the classes met were considered. The time allotment for

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[29]Ralph K. Watkins, "The Technique and Value of Project Teaching in General Science." Doctor's thesis, General Science Quarterly, 8: 235-311-342, 387-422, 1924.

TABLE XIII

TIME ALLOTMENT FOR STUDY

Length of Periods	Number of Schools	No. of times per week				
		1	2	3	4	5
15 minutes	4	0	0	1	0	3
20 minutes	17	0	0	12	1	4
25 minutes	7	0	0	6	0	1
30 minutes	23	0	1	13	2	7
35 minutes	1	0	0	1	0	0
40 minutes	12	1	0	9	2	0
45 minutes	23	3	4	15	0	1
50 minutes	0	0	0	0	0	0
55 minutes	0	0	0	0	0	0
60 minutes	4	1	1	1	0	1
65 minutes	1	0	0	0	0	1
Total	92					

26 schools had no definite division of time. Periods ranged from 45 minutes to 80 minutes.

59 schools had no study time in school.

11 schools required no home study.

4 schools used equal divisions of time.

28 schools gave other answers.

128 Total

study is shown in Table XIII.

In this group of ninety-two schools the average length of the study period is forty minutes. Twelve schools, or about 13 per cent of the whole group, have the average length of study time. Fifty-two schools representing 57.6 per cent of the group were having less than the average length of study time, while only slightly more than 30 per cent (28 schools) were having more than the average length of time for study. In the second group of one hundred and twenty-eight schools, 20 per cent had no definite division of time, 46 per cent allowed no study time in school, 9 per cent required home study, 3 per cent divided the time equally, and 22 per cent gave other answers. This table shows that there are many ideas and notions as to how long a study period should be. Also that there are too many schools not placing enough emphasis upon preparation. In the author's opinion even the average time of forty minutes is too short a time to prepare properly a lesson for class discussion. If little or no time is allowed during school hours, then it is the pupil's problem to find time for full or complete preparation. Since the table shows that 46 per cent of the second group have no study time in school and only 9 per cent have required home study, that leaves a large group of 45 per cent to shift for themselves. When high school students, many of tender years, are left to shift for themselves they may become rather careless in their study habits. Among the group of twenty-six schools having no definite

division of time the length of the periods ran all the way from forty-five minutes to eighty minutes in length. It is certain that any period longer than sixty minutes is a double period.

In the allotment for recitation there are even greater variations than in the study time. The periods of recitation ran all the way from twenty minutes in length to ninety minutes in length. The average length was forty-eight minutes, eight minutes more than the average length of time for study. Table XIV shows the length of periods, the number of schools using each period, and the number of times per week each type has recitations.

Of the group showing one hundred and sixty-three schools, 84.7 per cent were using less than the average length of time for recitation. One school was using the average length of time while only 14.7 per cent were using more than the average length of time.

In the second group, consisting of 40.5 per cent of the cases, the time was not divided between study and recitation in any definite ratio. This group said that they preferred to divide the time as they saw fit and as the occasion demanded. Their estimations of the approximate amount of time used for recitation ranged from thirty-five minutes to eighty minutes of time.

In the third group of thirty-four schools 7 per cent had equal divisions of time, 3.5 per cent had no recitation periods whatsoever, and 49 per cent gave other answers.

TABLE XIV

TIME ALLOTMENT FOR RECITATION

	Length of Period	Number of schools	No. of times per week				
			1	2	3	4	5
A.							
	20 minutes	4	0	0	1	0	3
	25 minutes	6	0	1	4	0	1
	30 minutes	23	0	0	16	2	5
	35 minutes	5	0	0	4	0	1
	40 minutes	42	0	2	34	1	5
	43 minutes	1	0	0	1	0	0
	45 minutes	57	3	8	40	2	4
	48 minutes	1	0	0	0	0	1
	50 minutes	5	0	0	5	0	0
	55 minutes	4	0	1	3	0	0
	60 minutes	13	0	6	7	0	0
	80 minutes	1	0	0	1	0	0
	90 minutes	1	0	0	1	0	0
	Total	163					
B.							
	35 minutes	1					
	40 minutes	1					
	45 minutes	6					
	55 minutes	1					
	60 minutes	8					
	67 minutes	1					
	80 minutes	1					
	no time stated	4					
	equal division of time	4					
	no recitations periods	2					
	Other answers	28					
	Total	57					
	Total of A and B	220					

TABLE XV

TIME ALLOTMENT FOR LABORATORY

	Length of Periods	Number of Schools	No. of times per week				
			1	2	3	4	5
A.	15 minutes	1	0	0	0	0	1
	20 minutes	1	0	0	0	0	1
	40 minutes	3	1	1	0	0	1
	45 minutes	18	0	18	0	0	0
	50 minutes	4	0	4	0	0	0
	55 minutes	5	0	4	1	0	0
	60 minutes	46	0	45	0	1	0
	65 minutes	1	0	1	0	0	0
	70 minutes	1	0	1	0	0	0
	75 minutes	1	0	1	0	0	0
	80 minutes	20	1	19	0	0	0
	82 minutes	1	0	1	0	0	0
	86 minutes	1	0	1	0	0	0
	90 minutes	40	0	40	0	0	0
	100 minutes	2	0	2	0	0	0
	110 minutes	1	0	1	0	0	0
	Total	146					
B.	No definite division, 20 to 80 minutes	30					
	No laboratory	11					
	equal division	5					
	Other answers	28					
	Total	74					
	Total of A and B	220					

TABLE XVI

SUMMARY OF TIME ALLOTMENT SHOWING PERCENTAGE

	Study	Recitation	Laboratory
Average length of time	40 min	48 minutes	71.5 min
Per cent of schools below average	57.6	84.7	55
Per cent above average	30	14.7	45
No definite division of time	20	40.5	40.5
Equal division of time	3	7	7
Not doing this type of work	0	3.5	15
Other answers	22	49	37.5

It will be noted that forty-eight minutes of time are consumed in disposing of forty-five minutes of preparation. A class of thirty pupils with an eight point assignment would have just five minutes for preparation of each point and each pupil would have approximately one and one-half minutes of class time for recitation. Unless the pupil uses some outside time the teacher cannot expect much from him.

The State Departments of Education located within the thirty states considered sent either letters, material, or the name and address of publishers who had charge of the printing of courses of study as a private enterprise. Some that were not too expensive the writer obtained. The final check revealed that the material was too meager on which to

base any accurate conclusion. However, literature of some sort was received from twenty-seven states. The courses of study to which the writer had some access revealed a few interesting facts. First, a number of states do not prescribe courses dealing with specific subjects, but prefer to confine themselves to a general course. Whether or not this is a desire on their part to refrain from tying the hands of school authorities or just a desire to be lenient and permit avenues of escape. Secondly, some states do not prescribe courses of study at all. It would seem that this generosity might work hardships upon the students. Each school corporation would be at liberty to make their own course of study and any student migrating from one section of the state to another might have some trouble establishing credits acceptable to the new school corporation. Thirdly, some states answered the letter of inquiry with the statement that such material could not be sent out of the state. The writer could see only one reason for such an attitude and that would be to reduce expenses. No doubt many such requests as this one come from all parts of the United States. Fourthly, some states do not have material relating to biology. Whether or not this is an indication that the subject, biology, receives little or no attention in those states, is not known, other than that which has been revealed in the discussion of the high school biology work.

A. Summary

The high schools of the United States are teaching all the branches of natural science. Approximately 75 per cent of them are teaching biology and the greater part of the remainder are teaching either botany, zoology, or physiology. The requirements for graduation in the biological sciences covered a rather wide range. There seems to be no very clearly established median as a requirement for graduation. Many and varying are the methods of teaching that are employed by the high school teachers of America. The two most widely used methods are the study-recitation and the laboratory. Of all the methods used the pupils seem to prefer the laboratory method. On an average not many field trips are made with the classes in biology. The average length of the study period in high school is forty minutes. The average length of the recitation time is forty-eight minutes and the average length of time for a laboratory period (double time) is seventy-one and a half minutes. The material that is available from the State Departments of Education is meager.

IV. CONCLUSIONS

The object of this thesis was to determine in a general way whether or not the courses offered in the teachers colleges were training teachers adequately to meet the problems of teaching in the high schools. The evidence has revealed that students majoring in biology were not given or required to take as much training in their particular line as were the majors in other departments. A minority precentage of the teacher training institutions were giving courses in the methods of teaching biology. Those students who were graduating with the degree, Bachelor of Science in Education, were getting more education than they were science. The departments in college were emphasizing the individual sciences when most of the positions in this field in the high schools are in the field of biology. The training given these pupils better fits them for teaching in college than in the secondary schools. In some states students are granted permits to teach before they had completed their training. It would seem that a well organized science department would have syllabi of their science courses, but it is not so in a very large per cent of the cases studies.

The teachers of biology in the high schools are copying, to some extent, the methods used in the teachers colleges. They are not making use of those methods that the latest researches have revealed to be the most profitable. More time is spent in study and recitation than is devoted to teaching

the pupils the various phenomena of life and their application to social welfare. Pupils are not given enough opportunity to experience the phenomena of their environment.

More intensive training in the latest and most profitable methods of teaching biology to secondary school pupils, to which should be added conferences for the exchange of ideas and further researches in the field of methods will further the solution of the problem which this thesis has presented.

V. APPENDIX

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