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Scope of Study: Two problems facing the secondary science teacher are finding time to prepare materials and apparatus for laboratory work and arranging time for students with high level ability to work on projects in which they have an interest. The purpose of this study was to discover a method of solving or reducing both these problems at once. The suggested methods of attack found in education textbooks, source books, and periodicals of the profession were found to be applicable mainly to the schools with larger enrollments and more adequate budgets than many of the schools of the Midwest. It is impossible in these schools to hire adult laboratory assistants, and equally impossible to provide special laboratories and teachers for accelerated programs for gifted students. By utilizing student laboratory assistants and requiring that they do some independent work, a number of benefits can accrue to faculty, students, and community. Indeed, the nation could well benefit from widespread exposure of more students to the methods and opportunities of science and scientists. Some of the problems which the paper attempts to answer are: (1) How, by whom, and upon what criteria should participants in the program be selected? (2) Shall the participants be given pay, credit, both, or neither? (3) What shall be the responsibilities of lab assistants? (4) What shall be required in the way of project work and research? (5) What are some techniques which may be utilized to assure success of the program? (6) What are some benefits of the program?

Findings and Conclusions: No doubt many schools are employing student laboratory assistants, but have not made public the results. Little material was found in print concerning this problem. What material was found, and what information could be obtained through personal inquiry has convinced the writer that a program for enrichment by use of student laboratory assistants is practical and feasible, and, can produce very definite and very desirable results.

ADVISER'S APPROVAL James H. Zant

ENRICHMENT OF HIGH SCHOOL SCIENCE OPPORTUNITY BY UTILIZATION OF A PROGRAM FOR STUDENT LABORATORY ASSISTANTS

By

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ENRICHMENT OF HIGH SCHOOL SCIENCE OPPORTUNITY

BY UTILIZATION OF A PROGRAM FOR

STUDENT LABORATORY ASSISTANTS

Approved:

Adviser

Dean of the Graduate School

PREFACE

This paper was undertaken because of the encounter by the writer with the problems mentioned therein, namely lack of time for project work by better students, and lack of time for adequate preparation of laboratory set ups in high school science courses. The purpose has been to try to discover in advance some of the problems which might arise in attempting to alleviate the aforementioned situation (and to circumvent as many of them as possible) in inaugurating a program for enrichment of high school science opportunity by utilization of student laboratory assistants.

The writer is indebted to Dr. James Zant, Dr. L. H. Bruneau, Mr. Claude W. Gatewood, Mr. Robert J. Tierney and to all other friends of the Academic Year Institute, all of whom have given of their time and contributed ideas, information, and encouragement during the writing of the paper. He is especially grateful to his wife, Jean, who has provided faithful encouragement and support throughout his work.

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CHAPTER I

THE PROBLEM

"Somehow equality of opportunity for all has been equated with identity of opportunity for all."[1] Concern over this situation has prompted much writing and lecturing about the need for special classes for the gifted, research rooms for the more interested, government aid for improvement of laboratory facilities, and so on.

The majority of these solutions are of little value to the smaller high schools. Increased room in the laboratory, more supplies, and equipment are of no use if the school cannot afford a larger faculty to handle the special classes; or if the enrollment is small there may not be enough capable, interested students to make a special program practicable. And, in spite of the fact that many educators feel that it is deplorable, many of the secondary schools are of such a size and have such a budget that the above conditions prevail.

Thus, any special opportunity for the more capable, more interested science student is relegated to the after school hours. Here, conflicts are encountered with practices for athletics, class plays, musical organizations, pep clubs and other clubs and social activities, church and community responsibilities. And, although most science teachers are

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[1] Paul F. Brandwein, The Gifted Student As Future Scientist (New York, 1955), p. xiii.

willing to spend the time, it encroaches upon the time for paper work and preparation for classes and laboratories.

> With five or six crowded classes in two or more science areas, jammed into short periods, the secondary school science teacher finds it extremely difficult to prepare and set up the necessary demonstrations and to set up the laboratory for student experimentation. A laboratory assistant can assume and carry out many of the non-teaching tasks which encroach upon the science teacher's classroom time and free him for his most important duty, teaching.[2]

Some of the problems which make special facilities and classes impractical for smaller schools are also in effect in preventing the hiring of trained laboratory assistants.

According to a study made by Samuel Schenberg[3] only a very few of the major cities (where the problems of space and budget and numbers of capable students would tend to be minimized) hire laboratory assistants. In his study of about fifty of the United States' larger communities, he found only three cities employing adult laboratory assistants--New York, Newark, and Baltimore.

It is the opinion of the present writer that a plan for the use of carefully selected students as laboratory assistants, and an accompanying opportunity for project work during school hours, can help alleviate the problems of relief of teachers from time-consuming nonteaching tasks, and provide an enrichment of the program for interested and capable students.

Formulation of a plan for use of laboratory assistants as a means of curriculum enrichment presents a number of aspects and problems:

1. How, by whom, and upon what criteria can participants be selected?

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[2]Samuel Schenberg, "A Study of the Nature and Extent of the Employment of Laboratory Assistants in the High Schools of the United States," The Science Teacher, XXII (1955), 231.

[3]Ibid., 231-234

2. Should the participants receive pay, credit, neither, or both?

3. What responsibilities can and should be given the assistant?

4. What additional work should be required in the way of projects, seminars, research, and the like?

5. What benefits, academic and non-academic, can be expected to accrue to student, school, and community?

Treatment of these and related questions will make up the remainder of this paper.

CHAPTER II

SELECTION OF ASSISTANTS

How, by whom, and upon what criteria can participants in a program for student laboratory assistants be selected?

This is an important problem. The need for scientists now, and in the future has received much publicity of late. Students who have potentialities which indicate that they might be capable and interested in helping to fill this gap should certainly be considered for additional opportunity such as can be given with a lab assistant program.

1. Future contributors to science may be identified on the school level.
   a. They may be identified by observation during a training program . . . to which admission and exit are freely guaranteed. [This is impractical in the school with a small enrollment.]
   b. They may be identified by a testing program.
2. Science "talent," better called high level ability or developed ability in science, is not a specific factor, but emerges out of general intelligence.
   a. High level ability in science is a combination of intellectual abilities, inherited and developed.
   b. The expression of high level ability in science is directly related to the early opportunities available for involvement in science.
3. The number of scientists in supply for future scientific operations is significantly related to the number involved in school science.
   a. Youngsters who like school science, and are successful in it on the school level, tend to make science a life work.
   b. The supply of a great number of <u>future</u> scientists for our greatly increased needs does not <u>primarily</u> depend on efforts by the colleges but on efforts on the school level.[4]

Seen in the light of a future effect, the importance of careful selection of laboratory assistants, over the nation, looms large.

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[4]Brandwein, pp. 25, 26.

There can be no set rules covering every case. "How often we have wished for a formula like $I = \frac{E}{R}$ or $E = mc^2$ (where E = educatability, m = materials of instruction, c = creativity) . . ."[2]

Lacking such a formula, identification of the student capable of utilizing extra opportunity must be accomplished by assaying certain characteristics and qualities of the student. What characteristics can be used to predict success in science? What qualities accompany high level ability in science?

> High level ability in science is based on the interaction of several factors—Genetic, Predisposing and Activating. All factors are generally necessary to the development of high level ability in science; no one of the factors is sufficient in itself.[3]

Brandwein defines these factors individually.[4] The Genetic Factor, he says, includes oral or written verbal ability, mathematical ability, neuromuscular control, especially of the hands, and adequate eyesight. This is based on the fact that these things may be inherited or greatly affected by heredity. Under the Predisposing Factor he would include persistence and questing. Presistence he defines as willingness to spend time, beyond the ordinary schedule, to withstand discomfort (such as shortened lunch hours, no holidays, etc.) and a willingness to face failure. The Activating Factor is described by Mr. Brandwein as the opportunity for advanced training and contact with an inspirational teacher.

> What makes for good scientific ability? . . . we are dealing with a complex subject. First, there is reason to believe that scientific ability is a function of high general intelligence. Second, whether it is a special ability that is inherited or one acquired and nurtured

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[2] Ibid., p. xv.

[3] Ibid., p. 12.

[4] Ibid., pp. 9-11.

through opportunities has never been clearly demonstrated. Third, it is easier to identify what accompanies scientific ability than to describe it itself. Scientific ability is linked with an unusually good ability to handle spatial concepts, sound judgment, strong powers of inductive reasoning, a certain fluency of ideas, good memory, and a quality that might be called a special kind of stick-to-itiveness.[5]

The use of tests to identify the more capable and interested student has been mentioned earlier. There are tests available to measure (with varying degrees of accuracy and reliability) nearly every trait from aptitude, to intelligence, to perseverance, to temperament and on through a spectrum of traits.

More and more schools, both large and small are coming to use a battery of tests which are periodically administered from kindergarten through high school. More and more are also hiring a counselor or psychologist to interpret the results of these tests. Since most science teachers are not adequately equipped educationally or time-wise to administer and interpret tests in selection of lab assistants, it is suggested that this be left to the counselor. The teacher, then, can go to the counselor and seek information and interpretation of tests already given to prospective assistants.

The teacher should, however, be certain that tests which will give the desired information are administered. If they are not, he should make every effort to persuade the counselor and school officials to implement the use of such tests.

If the student has had sufficient opportunity to partake in work of a scientific nature, he may have identified himself as interested in (and perhaps capable of) extra work in science. In any case, one should

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[5]Charles J. Cole, Jr., Encouraging Scientific Talent (New York, 1956), p. 25.

be certain that the student has an interest, along with high general intelligence, integrity, and the other desirable traits.

Interviews with other faculty members, the student's pastor, priest, or rabbi, and afterschool or summer employers may give some information pertinent to the selection of assistants. The permanent records of past scholastic and extracurricular achievement can be consulted.

Using these criteria, it might be a good idea to draw up an application blank to be filled out by the student. This also would accentuate the fact that the student is being chosen and would lend prestige to the position.

It is very desirable that the student have had the course, and if possible this should be a requirement. Exceptions would be in courses in which senior standing is a prerequisite for enrollment.

A program for use of student lab assistants has been in use for some time at Washington Union High School District, Fremont, California, according to Mr. Robert J. Tierney, teacher in the school. Selection is made in May of the year prior to appointment. The basis for selection is a minimum of a "B" average, and at least a B in the regular course. Beyond this, selection is left to the discretion of the teacher.

Robert O. Rogers, Rochester High School, Rochester Michigan, has the following requirements for biology laboratory assistants:[6]

1. Above average grades
2. Above average interest in this type of work
3. Must be able to work without constant supervision
4. One year of regular biology

Certainly the teacher should have the privilege and responsibility

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[6]Helen Boyd, Successful Devices in Teaching Biology (Portland, Maine, 1957), p. 27.

of selecting the laboratory assistants who are to work under him (perhaps subject to approval by principal or department head). And, if he has had the student in class before, he will indubitably have some very definite ideas as to his capability and desirability as a lab assistant.

This does not imply, however, that he should not use every means at his disposal--tests, interviews, written application, permanent records, etc.--to insure a wise and suitable selection.

In the final analysis, as in all of teaching, there must be added a pinch of understanding and intuition. Tests are not infallible; opinions of faculty, clergy, and employers may be invalid. Remember the unhappy childhood and misjudged ability of such men as Darwin, Einstein, and Edison. Do not attempt to correlate directly "test measured" I. Q. and creativity--they are not in direct relationship.

CHAPTER III

THE QUESTION OF PAY AND/OR CREDIT

Should student laboratory assistants receive pay, credit, both, or neither?

Schenberg[1] reports that four major cities--Atlanta, Boston, Oakland, and San Francisco--make special provision for use of high school students to assist science teachers. A number of other cities indicated that science teachers used students for assistance on a voluntary basis.

Atlanta gives one-half unit of credit for work in advanced physics or advanced chemistry.

Boston employs fifty pupil laboratory assistants to assist in maintenance of the laboratory, clean-up, keeping of attendance records, and securing and setting out materials for teachers. These assistants receive sixty cents per hour and may not work more than thirty hours per month. They spend up to five and one-half hours per day on the job.

Oakland and San Francisco employ bright students on a part time basis with token payment. The amount of payment was not stated.

The Rochester, Michigan program for biology lab assistants mentioned earlier provides for the student to receive one full year of credit for the course.[2]

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[1]Schenberg, pp. 233, 234.

[2]Boyd, p. 27.

The question of pay for work as a laboratory assistant must be considered in several lights and from several viewpoints. One of the problems mentioned earlier was the limitation of budget in many smaller schools.

Taking the pay scale quoted for student assistants in Boston, figuring an average work month of twenty-five hours, and using five lab assistants, the cost per year would approximate $675. In some budgets, this is a large appropriation, but it is a pittance compared to the cost of setting up special classes requiring the addition of a faculty member.

Probably most teachers have had capable students who would have been willing to take advantage of an opportunity for extra work in science during after school hours, if they had not had to hold an after school job. Students, forced by circumstances to work after school, might be able to take advantage of a lab assistant program which offered some payment. On the pay scale mentioned earlier, the student would receive only about fifteen dollars per month. This might be sufficient, however, to allow capable students who need an after school job to devote more time to science.

The type and amount of work involved must be considered also. If several lab assistants are in the program, after school work might be reduced to a minimum or eliminated. For a student to receive pay for work done during school hours might create some ill feeling among student body and community, especially if credit were being received at the same time.

This introduces the question of credit. Lab assistants are not to be mere bottle-washers. They are to be <u>assistants to the teacher</u> in a very real sense. This may involve such things as helping other students

during lab periods, which may call for some preparation and study in advance. Other duties, to be discussed later, will also take up time, but there should still be available a goodly quantity of time for project work and library research. Requiring such work presents a rather strong case for the extending of credit, and it is the manner in which the lab assistant program and special opportunity for more capable students can be incorporated.

Opportunity to earn credit, then, seems to be advisable. Objection may arise to payment for work if credit is offered. This suggests that perhaps the student might be paid for the portion of his time spent in actual "assistance" and receive credit for that portion of the work involving projects and research. A problem in bookkeeping and administration could develop if this were allowed to become too complicated, and the teacher would lose some of the time saved by having assistants.

Actually, neither pay nor credit should be the real motive for a student's seeking admission to the program. Either, however, might serve as some enticement, and some control during times when the student becomes a bit bored and might be tempted to "throw in the towel."

The problem of pay and credit cannot be solved here. Only some aspects can be presented, some pitfalls, and snags predicted, some suggestions made. The decision concerning pay and/or credit must be delayed until the particular situation can be evaluated and must be arrived at by those instituting the program.

CHAPTER IV

RESPONSIBILITIES OF LABORATORY ASSISTANTS

What responsibilities can and should be given to the lab assistant?

A mature student with high level ability should be capable of handling a variety of tasks as lab assistant, leaving the teacher more time for preparation and for giving individual help to students.

Many of the duties of hired lab assistants in New York City[1] could well be designated the responsibility of a capable student assistant. Some of these are:

1. Prepare demonstrations and set up labs.

2. Be present in the lab during experiments to keep set ups in order, replenish reagents, and to assist the teacher as needed.

3. Take approved safety precautions in transportation of equipment and supplies.

4. Assist in other ways for the welfare of the department.

5. Systematize storage for safety and easy access.

6. Maintain apparatus in usable condition.

7. Keep a running inventory of equipment and supplies.

Complete responsibility for the above should not be given to the student, but, under supervision, he can assist in all of them. With experience, more and more of the responsibility can be given to the assistant.

It is intended here to give generalized duties (unless otherwise

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[1] Schenberg, p. 231.

stated) which can be applied to any of the fields of science and to nearly any science course.

Brandwein lists some activities which he considers good for the enrichment of a program for more capable students. Some of these could as well be duties of a lab assistant. They are:

1. Preparing teaching material in chemistry, physics, or biology. . .
2. Assisting a science teacher in his field of special interest.
3. Maintaining a vivarium of forms particularly useful. . .[2]

Washington Union High School's program was mentioned earlier. The duties of biology assistants there are:

1. To prepare material for laboratory exercises in regular biology classes.

2. To maintain supply rooms and apparatus in the room.

3. To assist during laboratory periods.[3]

Robert O. Rogers' program in Rochester, Michigan, referred to above, requires the following from biology laboratory assistants:[4]

I. Biology Lab. Assistants
   A. Aid instructor in setting up experiments.
   B. To keep the lab in good order generally.
   C. Check equipment used by regular biology students.
   D. Correct tests and post grades in teacher's classbook. . .
      [A procedure most teachers, the writer included, might be reluctant to follow.]
II. Projects.
   A. Each student has a biology experiment that he works on part of each day. These are usually in the nature of a research problem.
   B. Other projects not definitely research in nature, such as:
      1. Organizing magazine articles into their various categories for classroom reference use.
      2. Working on a school insect collection.
      3. Setting up displays that may be used in the regular biology classroom.

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[2]Brandwein, p. 15.

[3]Information from Robert J. Tierney, teacher in the school

[4]Boyd, p. 27.

A chalk-board, clipboard, or similar means can be used to post in the supply room or other suitable place the duties for the day for each laboratory assistant. The student, upon reporting to class, can check the board, ask any necessary questions before class begins, and go about his work. It will also allow the student to know what to do should he have a free period in which he would like to work.

The lab assistant can be of much help during laboratory sessions, in answering student questions, getting materials for students, and assisting those with problems. Many of the laboratory problems--microscope adjustment, use of balances and scales, location of reagents and supplies, to name only a few--can be handled as well by a trained student assistant as by the teacher. One problem would be to teach the assistant to aid the students without doing their work for them.

The writer feels that the use of student lab assistants in grading papers should be very limited. Perhaps, the checking of lab drawings or workbook exercises and, perhaps, daily tests might be all right, occasionally. However, he believes that, properly set up and administered, laboratory assistant programs can free the teacher to do his own paper work. This, of course, will vary with the amount and type of paper work required; reliable students should be able to grade matching questions, multiple choice questions, and material of that sort as well as the instructor. Certainly, essay questions and other material calling for evaluation and judgment should fall to the teacher to take care of.

Responsibilities of student laboratory assistants must always be varied with the responsibleness of the assistant. It is to be hoped, however, that the above will provide some basic ideas for establishment of responsibilities in a lab assistant-enrichment program.

CHAPTER V

PROJECT AND RESEARCH REQUIREMENTS

What additional work in the way of project work and research should be required of the student laboratory assistant?

Herein lies the heart of the enrichment angle of the program.

To receive credit for his work (in the opinion of the present writer) the student should do more than serve as laboratory assistant. The lab services of the student will not be required every day. This will free some of his time for library research, project work in the lab, investigation of the fields of science as a career, and becoming acquainted with the scientist and his work in general.

It is necessary for the student to know how to use information available to him in order to do any valuable research or project work. Part of the requirements for credit should be a method of familiarization with the school library, any other libraries reasonably near, and the possibilities of interlibrary loans. One method of doing this is to require a library research project on a topic pertaining to the course and of interest to the student. This should be preceded by a period of explanation by the teacher or librarian as to how to find what one wants in the library.

The student may have a research project he wishes to attempt. If it is a problem of real interest and value, he may spend even more time on it than would be available within the limits of the course, or more than one year for that matter. If this is the case, he should be required to make satisfactory progress in this work--the decision as to what is satis-

factory being made by the teacher.

If a lengthy project is not already the desire and plan of the student, projects requiring less time may be undertaken, and the student expected to complete one each semester or term. These might be divided in several ways, depending on the course in which the program was offered. In biology, for instance, one might be botanical, the other zoological; one might deal with lower forms of life, the other with higher; one in physiology and one in genetics, and so on. In physics and chemistry similar divisions could be made, but flexibility of the program to the abilities and interests of the student should be maintained.

It is not necessary for projects to be pure research of a graduate level type to be valuable to the student and to the school. Even in dealing with above average or superior students, very few high school students are capable of tackling a serious problem in research, or have the background for such work.

Many other projects can be undertaken with valuable results. To name a very few: collection and preparation of study skins of birds for school use, (or other animals or plants), building models or demonstrations for class use, less complex investigations and questions in the students mind can be explored. In order for collections such as those mentioned to be of value, they must be carefully done, accurately labelled, and correctly preserved.

Projects will be of infinitely more value to the student if the idea for the project originates with the student himself. It may happen, however, that the idea may come from perusing books and magazines. Numerous books and magazines giving projedts for high school students are available and will not be taken up here.

The project should demonstrate or explain a scientific principle, or answer a question in the mind of the student.

The writer has some reservations as to the value of many projects he has seen at science fairs. However, one of the projects required might be prepared with entry in a science fair in mind, if a fair is conveniently available.

A period of discussion of topics in science, career opportunities in science, and problems that the students are meeting in their project work could be very usefully employed. In school of the size here being discussed, it would likely be desirable, or even necessary, for the assistants from the entire science department to meet together. In larger schools the students from the separate courses might meet together profitably.

Topics of discussion would vary with the background and interests of the students. The opportunities in science careers could be discussed with nearly any assortment, however, and probably with good results. There is available a little book called Your Future in Science[1] covering the need for, opportunities for, methods of, and requirements for becoming scientists. This book, or one like it, could be a "text" for a portion of the discussion period each meeting, or as the topic for a number of meetings.

Frequency of "seminars" will be restricted by the time available. Remember, one of the reasons for the development of the laboratory assistant-enrichment plan was to by-pass the conflicts with other activities. If a time for meeting during school hours can be arranged, this would be the most desirable.

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[1]Morris Meister and Paul F. Brandwein, Your Future in Science (Chicago, 1958).

Some schedules contain an activity period which might be used. If students do not have to ride a bus to school, and could therefore report before or after school hours on occasion, this time could be utilized. If it is necessary to meet outside school time, meetings should probably be restricted to weekly, bi-weekly, or monthly, depending on the circumstances of students and teachers.

The grade for the course should be based upon successful completion of the requirements, along with other such conventional standards as quality of assistance rendered the class and teacher, attitudes of assistant, etc. Standards used in determining the grade should be explained to the student in advance, and the reasons for the grade explained in a meeting between the teacher and each assistant at the completion of the course.

CHAPTER VI

MISCELLANEOUS PROBLEMS AND SUGGESTIONS

Scheduling the students's classes so that he will have a free period at the time of the class in which he is to be an assistant will indubitably be one of the biggest problems in development of a program for student laboratory assistants. This, of course, cannot be solved in this paper, but must be met by the inaugurator of any such program at the time and on the spot.

The smaller the school, the more acute this problem becomes. If, for instance, there is only one biology class, and it occurs at the same time as the American History class required of seniors for graduation, use of senior lab assistants becomes much more of a problem than when there are five biology classes and five history classes.

One purpose of the program is to avoid more costly programs and the purchase of extra equipment, while still providing extra opportunity. Nevertheless, if any funds at all are available, some equipment is desirable, especially if there is some unused corner which can be set aside for the work of lab assistants.

> Gifted students should have at their disposal a research room and equipment for the construction and manipulation of a wide variety of apparatus . . . Typically, such a room has a good set of hand tools, power tools, and basic supplies. . . Each student who is permitted to use the room is given a pass signed by the science teacher. His freedom to use the room is conditioned on the degree to which he does serious work, which is determined by individual conferences with the science teacher, written reports of progress, and weekly seminars with the other like-

minded students who are given the opportunity to work in the research room.[1]

The extent to which this can be realized is, of course, determined by availability of space and funds. Actually, the former is probably the more limiting factor, for the cost of a basic set of hand tools, assorted nails and screws, odds and ends of lumber and metal, and other needs common to many projects is relatively low.

If students participating in the program are carefully chosen, the problem of supervision should not be of great magnitude. Supervision should amount only to that which is required to keep the students working and progressing.

> . . . the success of this program depends a great deal on the students; they must have genuine interest in this field and must be able to carry on their work without continual supervision. . . This has been their one big chance in High School to do some real original thinking and to carry out work without a set of rigid regulations controlling their every effort.[2]

The key words in the preceding paragraph are "continual supervision." Some supervision is certainly necessary. For that matter, the students will desire some guidance and assistance in their work, and will achieve better results if it is carefully offered.

> When the sponsor was available, that is, when he "dropped in" regularly so that he could suggest further references and a way out of difficulties (yet without giving the solution); when goals were arrived at in full discussion and in common agreement; when a permissive (not coercive, autocratic, or laissez-faire) attitude prevailed, there was a noticeable growth in the ability of the youngsters to work effectively.[3]

The number of lab assistants per class, or the number working on projects at one time will have a very definite effect on the amount of

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[1] R. Will Burnett, Teaching Science in the Secondary School (New York, 1957), p. 212.

[2] Boyd, p. 28.

[3] Brandwein, p. 52.

supervision needed. Recall the adage about "one boy, a whole boy; two boys, half a boy; three boys, no boy at all." (And the same might be said for girls.) For this reason, it would probably be best to have only one student assistant per class. This should not be an iron-clad rule, for the growth of the student is the first consideration at hand. If there are two, or perhaps even three, deserving and eager students who can schedule during only one period of the day, most interested teachers would be willing to accept them, at least probationally.

There has arisen, in some areas, an antagonism against "intellectuals" or "eggheads." This has resulted in some social pressure against excelling scholastically in high school. Properly utilized, a program for laboratory assistants can combat this. A number of techniques may be used.

Mr. Claude Gatewood, of Oklahoma State University, suggests the use of letters of commendation or recommendation to registrars of colleges or universities to which the graduating lab assistant applies. In addition, he suggests that a copy of the letter be placed in the permanent records of the student, another copy in the teacher's file. This letter should explain the program in which the student participated; should tell of the work done by the student, the progress made and projects undertaken.

A prestige technique employed in the Washington Union High School District, Fremont, California (according to information from Mr. R. J. Tierney, teacher there) is the use of lab coats as an insignia of position. He says, "Biology assistants are entitled to wear a lab coat, and generally are looked upon as outstanding students."

Another practice in use for the general student body in some schools is the awarding of scholastic letters, similar to athletic letters. If

this is the practice in the school, it might be possible to devise a symbol for laboratory assistanceship to be added to the letter upon attainment of the position or completion of the course. If letters are not awarded in the school, some other symbol of achievement might be utilized effectively.

It is up to the one in charge of the program to see to it that it is, and remains, an honor and a privilege to be a laboratory assistant. Only by careful choosing of participants, continual challenging of the ability of the assistant, and the development and maintaining of mutual respect between supervisor and assistant and between assistant and fellow students can this be accomplished.

CHAPTER VII

SUMMARY OF BENEFITS

What are some of the benefits, academic and non-academic, which may be derived from a program of enrichment by use of student laboratory assistants?

Benefits from the type of program here outlined are, the writer hopes, evident throughout the extent of this report. To set down some of these reasons for and results of a lab assistant program is the purpose of this chapter, in the manner of conclusion.

Opportunity for capable students to do additional work in science is both reason and result of the program. Besides the project work involved, assisting in the laboratory can be a valuable experience.

Recognition of high level ability in and possible future contribution to science should result from, and be involved in, careful selection of participants. This recognition should not only be by the faculty, but should lead to self-recognition as potential scientist by the student.

Laboratory assistants can, by doing many of the time-consuming non-teaching tasks about the lab, release the teacher for more important tasks and class preparation.

Real responsibilities in these duties will fall upon the laboratory assistant, and can result in his learning to better accept responsibility.

Other pupils in the laboratory can derive real benefit in their work by having present, not only the teacher, but students who have done the work before and can assist them with problems and answer some of their

questions about the work.

Incentives and goals can be a result of the program, especially if it is developed to the extent that better students consciously compete for the honor and privilege of being chosen as a laboratory assistant in a course in which they are particularly interested and capable.

Especially in those communities in which students who excel in academics are considered by fellow students to be "eggheads," and held in some social disdain, the program can act as a remedy for anti-intellectual feelings. Newspaper coverage of appointment of assistants, and of any subsequent achievements such as science fair competition, use of prestige measures such as white lab coats, passes to go to the lab during free periods, etc., can be effective. Obvious respect for the assistant on the part of the teacher, when such respect is deserved, may help also.

A letter to the registrars of colleges or universities to which the graduating lab assistants apply may result in recognition by the general student body that it does pay to do well scholastically in high school.

Often, once a student is inspired and motivated, he will provide a challenge to the teacher. This may be followed by the teacher performing his duties better, thereby challenging more students--a benefit to the students, school in its entirety, community, and ultimately a benefit to the nation.

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