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# AN ANALYSIS OF OPINIONS HELD BY OKLAHOMA SCIENCE TEACHERS AND SCHOOL ADMINISTRATORS OF THE FIFTH-YEAR-GRADUATE PROGRAM FOR SCIENCE TEACHERS

A DISSERTATION

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AN ANALYSIS OF OPINIONS HELD BY OKLAHOMA SCIENCE TEACHERS AND SCHOOL ADMINISTRATORS OF THE FIFTH-YEAR-GRADUATE PROGRAM FOR SCIENCE TEACHERS

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# AN ANALYSIS OF OPINIONS HELD BY OKLAHOMA SCIENCE TEACHERS AND SCHOOL ADMINISTRATORS OF THE FIFTH-YEAR-GRADUATE PROGRAM FOR SCIENCE TEACHERS

## CHAPTER I

## INTRODUCTION

Education is a matter of concern to both educators and the public, and education of teachers is an important part of that concern. Pressure toward higher educational standards for teachers and continued examination of graduate programs open to teachers are evidences of concern for teacher preparation. Increased educational requirements for teachers and the practice of the public school system to use higher degrees as a basis for increased salary and rating of teachers have contributed to the development of the master's degree program for teachers.

But the master's degree itself has been under examination. The nature and true function of the master's degree, its best uses and possible modifications in requirements, have been subjects of discussion during the twentieth century. Walter Crosby Eells points out some of the unresolved problems relative to the master's degree. He asks such questions as the following:

> Should the master's degree be regarded as a terminal degree, significant in itself? If so, for what purposes or positions? Chiefly for secondary-school teachers, or for college teachers? Should it be concerned with subject matter or should it include pedagogical methodology? Should it be thought of merely as a stepping stone on the way to the doctorate? Should the period of study for it be increased to two years? Should a thesis or dissertation be required?[1]

These and related questions which have been the subject of debate for almost a century are of considerable consequence to the public school teacher who is a major recipient of the master's degree.

Should the master's degree program for the secondary school science teacher be the same as that designed for the research scientist? Should the program for the science teacher include only advanced courses in his subject area? Should his program include appropriate professional education? Should specially designed science courses for teachers be available to the teacher in his graduate work? Should research in his science field be required of the high school science teacher? Should a thesis be required? These along with other questions arise when considering advanced education for the science teacher.

That the teacher is a principal recipient of the master's degree is supported by data which will be presented. These data show that the master's degree in education makes up a significant number of the degrees awarded each year. Assuming that those receiving these degrees are engaged in the profession of education, what should be the character of the degree in order that it be most useful to its principal recipient, the teacher? This last question is to be the major concern of this study.

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[1]Walter Crosby Eells, Degrees in Higher Education (Washington, D. C. The Center for Applied Research in Education, Inc., 1963), p. 80.

There are several factors which help to create the demand for the master's degree by teachers. With the ever-increasing quantity of knowledge in the subject fields and the developing understanding of the learning process, the prospective teacher is hard pressed in four academic years to acquire the prerequisites for competent teaching. He very soon feels the needs and pressures for advanced education. Also contributing to the demand for advanced degrees by teachers are established professional standards. J. Kenneth Little states that the most important single factor favoring the growth in the number of master's degrees has been the increase in educational standards for public school teachers established by state and local school boards. In some states the requirement that teachers have a master's degree for full certification is written into state certification requirements. Also, salary schedules usually reward teachers who have earned the master's degree.[2] W. G. Kessel makes the related observation that the necessity for additional education beyond the bachelor's degree has forced many secondary school teachers into graduate schools. He observes further that traditionally they have followed one of two patterns--work in their particular discipline or work in education.[3]

A large number of the master's degrees conferred each year are earned by teachers carrying out their graduate work in schools or departments of education. The relatively large number of master's degrees

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[2]J. Kenneth Little, "Graduate Education," Encyclopedia of Educational Research, ed. Chester W. Harris. (New York: The MacMillan Co., 1960), p. 597.

[3]W. G. Kessel, "The Status of Special Graduate Courses for the High School Chemistry Teacher," School Science and Mathematics, LVIII, (May, 1958), p. 404.

awarded in education in the United States and the number awarded in all fields are shown by year with the following data.[4]

MASTER'S DEGREES EARNED

| Total | Year | Education |
|---|---|---|
| 91,418 | 1962-63 | 37,522 |
| 84,889 | 1961-62 | 35,932 |
| 78,269 | 1960-61 | 33,850 |
| 74,497 | 1959-60 | 33,512 |
| 69,584 | 1958-59 | 31,569 |
| 65,614 | 1957-58 | 31,112 |
| 61,955 | 1956-57 | 30,972 |
| 59,294 | 1955-56 | 30,026 |

The degrees earned in education can be assumed to have been earned by people preparing themselves for careers in teaching or administration.

The same growth in the number of master's degrees awarded and the distribution in education is observed in Oklahoma, according to information from the Oklahoma State Regents for Higher Education. The total number of master's degrees awarded from all colleges and universities in the state in 1966-67 was 2,173; that figure represents a 58.0 per cent increase over the number awarded in 1961-62. Nine hundred seventy-five (44.9 per cent) of the master's degrees awarded in Oklahoma in 1966-67 were earned in education; presumably by teachers and administrators. The six state colleges of Oklahoma, which award the Master of Teaching degree, a degree designed for teachers, awarded 701 master's degrees in 1966-67; that figure represents a 60.8 per cent increase over the number awarded by these schools in 1961-62. The increase in the number of master's degrees in education awarded by all the schools

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[4]Patricia Wright, Earned Degrees Conferred 1962-63, Bachelors and Higher Degrees, U. S. Department of Health, Education, and Welfare (Washington, D. C.: U. S. Government Printing Office, 1965), p. 5.

in Oklahoma over the same period of time was 22.8 per cent.[5] In addition to the large number of master's degrees earned by teachers in the field of education each year, many of the master's degrees earned in subject-matter fields taught in high school are awarded to secondary school teachers teaching in those areas.[6, 7]

## The Need

Concern regarding the advanced education available for teachers persists. Little, in discussing graduate education, states:

> One of the pressing unsolved problems of graduate schools has been the development of an adequate program of advanced studies for elementary and secondary school teachers. This problem brings sharply into focus the differences in philosophy between graduate programs which emphasize professional studies and advancement and those which concentrate upon preparation for research.[8]

The needs and objectives of the high school science teacher in his graduate work would hardly seem to be the same as those of the research scientist. An experienced teacher should be able to provide a peculiar insight to his needs in a program of advanced study which should better fit him to meet the challenges he encounters teaching in a developing school curriculum.

A not uncommonly held view of the general problem of teacher education, which bears out the need for this study, is that expressed

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[5]Tables of information on degrees conferred in Oklahoma colleges and universities over the past ten years. Oklahoma State Regents for Higher Education, Oklahoma City, Oklahoma, 1967.

[6]Little, p. 597.

[7]John Snell, "The Master's Degree" Graduate Education Today, ed. Everett Walters (Washington, D. C.: The American Council on Education, 1965), p. 76.

[8]Little, p. 599.

by John I. Goodlad:

> All too commonly, curriculum development in teacher education is a haphazard process, guided largely through debate, in which arbitrarily selected pieces of undetermined value are shuffled into kaleidoscopic patterns. The personal synthesis desired in professional behavior occurs by chance, if at all, simply because not all of the components essential to this synthesis are first brought into the curriculum design.[9]

This observation might apply equally well to graduate teacher education. An examination of transcripts of ten randomly selected graduates of master of teaching programs with a science concentration showed quite diverse records. Professional education and psychology made up from a high of 55 per cent to a low of 25 per cent of individual graduate programs. Semester hours in science constituted from 65.5 per cent (75 per cent science and mathematics) to a low of 34 per cent of the program. Individual programs often appeared to be a result of expediency rather than design.

For those concerned with the education of the science teacher and teachers in general, beyond the baccalaureate, the basic question is how to design suitable master's degree programs to meet the needs of the teacher in both professional education and the discipline of science. The lack of firmly established guidelines which define the precise nature and amount of subject matter concentration and professional education required for the master's degree has been suggested as a reason for the debate.[10]

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[9]John I. Goodlad, "The Professional Curriculum of Teachers," The Journal of Teacher Education, XI, (December, 1960), p. 455.

[10]T. P. Fraser, "A Reasonable Approach to a Master's Degree Program for Secondary School Science Teachers," School Science and Mathematics, LXVI (December, 1966), p. 793.

James H. Otto has observed in a symposium on the campus of Indiana State Teachers College that the graduate-study needs of a secondary teacher are different from those of a person preparing for research or college teaching. The teacher often needs to broaden his academic background and for this reason may need subject matter courses in the fifth year which normally are not graduate level in that area.[11] Courses designed to fit the graduate-study needs of the high school science teacher would seem to be most desirable.

Among persons directly concerned with the problem of a suitable master's degree program for secondary school teachers are the specialists in professional education and those in subject areas who are responsible for implementing the program, the secondary school teacher who utilizes the program, and the school administrator who employs the product of the program--the teacher. The specialists in professional education and those in subject areas are present on the college and university campuses and are available for consultation. The person whose needs should be met by the program, the teacher, and the school administrator who employs the teacher, are not so accessible. The objectively obtained opinions expressed by the latter two groups, not available previously, would make a most valuable and significant contribution to the formulation of a suitable graduate program of teacher education. This information is made available by this study.

The deans of the state colleges of Oklahoma, who direct the programs of advanced teacher education in those schools, were asked to

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[11]James H. Otto, "How Can the Revised Standards Be Used to Improve Special Teaching Areas in Teacher Education Programs in Indiana," The Teachers College Journal, XXXIII (May, 1962), p. 175.

indicate their reaction as to the need for this study. Without exception, they indicated a need for the research and an interest in the results. A number of comments were made in written responses to the investigator. Portions of those responses are quoted:

Dr. E. C. Hall, Dean of the Graduate School, Central State College, Edmond, Oklahoma, said, "It appears to me that the study is well focused."[12]

Dr. V. W. Burrows, Graduate Dean, Northeastern State College, Tahlequah, Oklahoma, said, "It would be interesting and helpful to know whether graduate education for the science teacher should include both science and education courses or exclusively science courses; also whether the student should have courses in several sciences rather than to concentrate chiefly on one of the sciences; also whether mathematics should be included."[13]

Dr. Harold Massey, Graduate Dean, Southwestern State College, Weatherford, Oklahoma, comments, "In view of the wide variations that exist in such programs throughout the country, it would seem that institutions offering fifth-year preparation for science teachers should welcome a study of this kind as a means of developing the best possible program in this field."[14]

In addition, Dr. Ernest Sturch, Jr., Head of the Department of Physical Science, Southeastern State College, Durant, Oklahoma said,

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[12]E. C. Hall, personal letter, November, 1967.

[13]V. W. Burrows, personal letter, November, 1967.

[14]Harold Massey, personal letter, November, 1967.

"Such a study should be a great help in designing a more realistic curriculum for these 'experienced teachers'."[15]

The results of the study suggest several probable benefits. The information obtained, representing opinions of school administrators and of the consumers of this advanced education, the high school science teachers, provides a basis for evaluation of present programs of graduate education for science teachers in secondary schools. The data provide a basis for recommendations for fifth-year programs of science-teacher education as well as for the formulation of guidelines for a program of advanced study which will be suited to the needs of the science teachers in the high schools of Oklahoma. Also, suggestions for further research result.

## The Problem

The problem to which this study addresses itself is to determine what secondary school science teachers who have completed a fifth year of study and school administrators who employ science teachers believe to be the most desirable characteristics of a fifth-year program for secondary school science teachers.

The specific purposes of the research are: (1) to obtain opinions concerning the first year of graduate education from science teachers in the secondary schools of Oklahoma who hold master's degrees, (2) to obtain opinions about the same items from school administrators who are responsible for selecting competent teachers, and (3) to interpret the findings of this study with regard to guidelines and suggestions relative

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[15]Ernest Sturch, Jr., personal letter, November, 1967.

to a desirable fifth year of graduate education for secondary school science teachers.

## Major Assumptions

1. The information needed can be obtained from teachers who have completed a master's degree and from school administrators by using a questionnaire.
2. Opinions of secondary school science teachers and those of school administrators are valid. (This seems to be a reasonable assumption since the teachers sampled have satisfactorily completed a graduate program and the position of school administrator requires that judgement be made regarding what is satisfactory preparation for a teacher.)

## Limitations

1. The study is limited to the opinions of high school science teachers of Oklahoma high schools who have completed a master's degree program.
2. A stratified sample of school administrators is used. The stratification was made on the basis of school enrollment.

Regardless of the restraining aspects of the "Assumptions" or "Limitations," the information collected and interpreted will represent the only available evaluation of the fifth year of study in science and education made by its consumers--high school science teachers. Since these people use their college-developed skills and understandings daily, they provide the best available source of evaluations which will be particularly valuable to institutions planning graduate-study opportunities.

## CHAPTER II

## REVIEW OF RELATED LITERATURE

While a great deal has been written concerning the education of teachers beyond the traditional four-year bachelor's degree, the amount of research available seems limited. In 1953, J. E. Williams[1] did a study dealing with the general problems of the first year of advanced professional education of teachers in which he used opinions of classroom teachers. Three other studies have been made concerning the fifth year of teacher education by the questionnaire method. D. E. Small[2] did a study of the opinions of secondary mathematics teachers and William E. Boyd[3] used similar techniques with biology teachers. The following year Ernest W. Horn[4] conducted a study of the opinions

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[1]J. E. Williams, "Opinions of Selected Classroom Teachers Concerning the First Year of Advanced Professional Education," (unpublished Ed. D. dissertation, School of Education, Indiana University, 1953).

[2]D. E. Small, "Opinions of Secondary Mathematics Teachers Concerning the Fifth Year of Training for Mathematics Teachers," (unpublished Ed. D. dissertation, School of Education, Indiana University, 1955).

[3]William E. Boyd, "Opinions of High School Biology Teachers Concerning the Fifth Year of Training for Biology Teachers," (unpublished Ed. D. dissertation, School of Education, Indiana University, 1956).

[4]Ernest W. Horn, "An Analysis of the Opinions of Indiana Secondary Social Studies Teachers Concerning the Fifth Year of Teacher Education," (unpublished Ed. D. dissertation, School of Education, Indiana University, 1957).

of secondary social studies teachers concerning the fifth year of teacher education for that group.

Of the above cited studies, only that of Boyd's deals with science teachers as such and his study is limited to the opinions of a sample of high school biology teachers. Twelve of Boyd's conclusions follow:

1. Biology courses, including laboratory, should constitute at least fifty per cent of the fifth-year program of teacher training for biology teachers.
2. Approximately fifteen per cent of the fifth-year program should be devoted to each of the areas: research, professional education courses, and observation and advanced student teaching.
3. Advanced methods courses should be offered and conducted cooperatively by the education department and biology departments.
4. The fifth year should provide workshops that combine the areas of biology and other fields of science for a better understanding of their interdependence.
5. The fifth year should provide adequate laboratory facilities so that teachers may have experience working with audio-visual, curriculum, and laboratory materials related to biology.
6. The fifth year should provide the use of campus laboratory schools or cooperating schools for demonstration, research, and experimentation.
7. The fifth year should use instructional methods which emphasize demonstrations, class participation, and the use of audio-visual materials.
8. Students should be encouraged to have at least one year of full-time teaching experience before entering the fifth-year program.
9. The fifth year should provide advanced courses in biology designed especially for secondary teachers.
10. The fifth year should not be considered a fifth year of teacher training without awarding a master's degree.
11. The fifth year should provide introductory courses in related science offering graduate credit, without prerequisites, and prepared especially for secondary teachers.
12. Biology courses and courses related to biology and the teaching of biology are of greater importance in the fifth-year program for biology teachers; audio-visual aids courses and professional education courses are of less importance in the fifth-year program.[5]

The character and content of fifth-year programs for teachers discussed in the literature cover a wide scope. D. F. X. Finnegan has

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[5]Boyd, p. 73.

characterized these programs as being of three general types. (1) One type of fifth-year program involves the continuation of work after the awarding of the baccalaureate degree in order to obtain state certification. It is a continuous program which is initiated at the undergraduate level and reaches its culmination at the end of the fifth year. The fifth-year work might be upper level or graduate. (2) Another type of fifth-year program could be one in which the fifth-year is completed by utilizing summer schools and evening classes on campus while employed full time as a teacher. Full certification is obtained upon the completion of the fifth-year work. (3) The third type of fifth-year program involves the attainment of a master's degree.

The types and titles of master's degrees are of diverse sorts. The master's may be a straight master of arts or master of science degree in a subject field or a master of education degree in professional education utilizing such fields as guidance or administration. It may also be a graduate program especially designed for teachers leading to the master of education or master of arts in teaching (M. A. T.) degree in which both professional education and subject field courses are taken. There are at least two types of M. A. T. programs: (1) those involving further course work in teaching fields and in advanced professional education courses; or (2) those involving subject matter course work, some professional education courses, and "an internship" program.[6]

William P. Holden, in discussing the M. A. T. program at Yale, observed that the courses taken were about equally divided between

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[6]D. F. X. Finnegan, "Why and How of Organizing a Five-Year Program of Teacher Education," National Catholic Educational Association Bulletin, LXI, (August, 1964), pp. 184-90.

graduate courses in a subject area and professional courses in education. If, however, the student had had substantial training in professional education before entering the program, he did not repeat those courses. Thus, given some background in education, he took more than half his work in his subject. Science students usually tried to get a competency in a second science or in mathematics, since they commonly would be asked to teach more than one science.[7]

The M. A. T. program at the University of Chicago, according to Hugo E. Beck, requires two years for completion and is of the internship type. The rationale of the program is expressed in three statements of basic convictions which underlie the program.

1. Effective teaching requires not only the possession of a substantial body of knowledge in the subject taught but also--and perhaps more important--an understanding of the methods of inquiry through which knowledge in the particular field is discovered, tested, and extended.
2. The practice of teaching can be engaged in on a professional level only when the teacher has developed productive ways of thinking about the learning process, the roles of schools in different social settings, and other problems of education.
3. Proficiency in the arts of teaching is most likely to develop when there is extended opportunity for observation of skilled practitioners, for experience in teaching under varying conditions, and for analysis of observations and experience in the light both of the particular discipline in which the field of teaching is located and of different philosophies of education and theories of learning.[8]

A type of M. A. T. program is offered by the state colleges of Oklahoma. This fifth-year program was said to be designed and implemented

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[7]William P. Holden, "The Master of Arts in Teaching at Yale, 1951-58," The Journal of Teacher Education, X, (December, 1959), p. 394.

[8]Hugo E. Beck, "The Teacher Scholar: A Two-Year Program," Changes in Teacher Education: An Appraisal, National Commission on Teacher Education and Professional Standards, Official Report, 1963 (Washington, D. C.: National Education Association, 1964), pp. 113-15.

with the specific needs of the classroom teacher in view. With few specific course requirements, its aim was to fill the needs of the individual teacher with a tailor-made program. As conceived, it was considered primarily as a terminal program and not as intermediate between the baccalaureate and doctorate.[9]

W. G. Kessel reports that of the 426 colleges and universities listed in the 1956-57 Education Directory of the United States Department of Health, Education and Welfare as offering a master's degree, only twenty-eight were found to offer a program that was sufficiently different to be classified as a special degree program designed for the mathematics and science teachers in the secondary schools. The two state universities of Oklahoma were among the twenty-eight schools listed. Several other schools indicated that they utilized "tailored" courses for teachers within the existing degree program.[10]

The teacher, as a matter of expediency, often engages in a master's degree program not suited to his needs. Recognizing the fact that many high school science teachers may have too few hours of science to be admitted to graduate courses, the proposal has been made that science departments should develop special graduate courses specifically designed to upgrade science teachers in a minimum time.[11]

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[9]James F. Rogers, "Oklahoma's Fifth-year Program," The Teachers College Journal, XXVIII, (October, 1956), p. 8.

[10]Kessel, School Science and Mathematics, LVIII, pp. 405-06.

[11]Joint Commission on the Education of Teachers of Science and Mathematics, Improving Science and Mathematics Programs in American Schools (Washington, D. C.: American Association for the Advancement of Science and American Association of Colleges for Teacher Education, 1960), p. 28.

At the Fourth Statewide Conference on the Fifth Year in Teacher Education held on the campus of Indiana State Teachers College in 1955 agreement was reached on a number of concepts concerning the content of the fifth year of teacher education. Some of the concepts of particular interest in this study are:

1. The program should provide students the opportunity to broaden and to increase their knowledge in teaching fields.
2. The fifth year should broaden the student's understanding of the foundation areas of education such as philosophy and the history of education.
3. The fifth year should provide students with the opportunity to broaden their cultural background through general education courses.
4. The program should aim to increase the professional competencies of the classroom teacher, to increase their knowledge in the area of professional education, and to provide the students with the opportunity to critically examine educational theory and method.

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7. The program should emphasize advanced methods of teaching and the ability to teach.
8. The fifth-year curriculum should provide broad professional laboratory experiences, especially direct experiences with children.

.....

12. The fifth year should provide the students with a better understanding of the guidance function of a classroom teacher, an understanding of the nature of extra-class activities, the knowledge of audio-visual education, and an understanding of the role of the teacher in school administration, including finances.

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14. The fifth year should instill an understanding of the need for scientific inquiry in education so that the students will carry that understanding over into their teaching assignments.[12]

In addition to agreement on general concepts concerning the content of the fifth year of teacher education, a set of concepts concerning the organization and administration of the fifth-year program

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[12]Howard T. Batchelder, "An Analysis of Outcomes of the Conferences on the Fifth Year of Teacher Education," The Teachers College Journal, XXVII, (October, 1955), pp. 6-7.

were agreed upon and presented. Four concepts concerning the fifth year in teacher education upon which agreement was not reached were:

1. The amount of teaching experience required of individuals entering the fifth-year program.
2. The degree of rigidity that fifth-year programs should maintain.
3. The amount of practical and theoretical research requirements in the fifth year.
4. Whether or not the fifth year should culminate in a master's degree.[13]

The work done by the study group working in the science area is of particular concern to this study. That group arrived at the following general principles which should govern the fifth-year program in teacher education as it concerns the science teacher:

1. The fifth year should be a balanced program including work in general education, field of specialization, and professional education, with emphasis in this order.
2. It is strongly recommended that the fifth-year program not be completed before the student has had on-the-job practical experience.
3. Flexibility should be permitted in planning the program. This means flexibility for the institution to organize its own program and flexibility to plan a specific program for an individual student.
4. Flexibility does not mean lack of planning. All programs for the fifth year should be carefully planned under the guidance of competent faculty advisors at a teacher training institution.
5. Each institution should establish a faculty committee with broad representation from various schools and departments to determine policies regarding the fifth-year program.
6. The planned fifth-year program for an individual student should be related to: (a) his previous four years of education, and (b) his personal needs as determined from practical field experience.[14]

In keeping with the principles formulated, the following implications in terms of the actual program were agreed upon:

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[13] Ibid.

[14] Reports of Study Groups--Science, The Teachers College Journal, XXVII, (October, 1955), p. 12.

1. Each department in a teacher training institution must accept responsibility for helping meet the needs of the fifth-year student. They must offer courses needed for advanced preparation in each special area.
2. A person who has successfully completed his planned and balanced program should be granted a master's degree.
3. Courses should be available without prerequisites for persons needing them to balance and broaden their planned program.
4. Schools should offer opportunity for recognition and compensation to encourage each teacher to continue and advance as a teacher in his speciality.[15]

In considering the content of the fifth-year program of the secondary school science teacher the observation was made that the science teacher almost always teaches more than one science or other subject. For this reason the feeling was that breadth of training is necessary. Also, while a flexible program was strongly recommended, the conclusion was reached that at least half of the program should be in the field of science. The following recommendations were made relative to the content of the fifth-year program for secondary school science teachers:

I. Three areas of science training or experience should be adequately covered before completion of the fifth year:
   A. An integrated (not survey) course in modern and basic concepts of science, cutting across traditional scientific boundaries.
   B. Advanced training in laboratory work--for demonstrations, illustrations, and experiments. This would be the teaching of methods through subject matter.
   C. Advanced work in one science of special interest to the "fifth-year" teacher.

II. During the "fifth-year" the student should have opportunity to develop further his understanding of the social and psychological aspects of education through advanced work not duplicating his previous training.

III. The balance of the "fifth-year" program should be entirely flexible. It should provide opportunity for the student to broaden his cultural background through general education courses and to meet any requirements of the institution.[16]

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[15] Ibid.

[16] Ibid., pp. 12-13.

During the year following the conference at Indiana State Teachers College a statement of policy concerning the characteristics of post baccalaureate study for classroom teachers was adopted by the Commission on Colleges and Universities of the North Central Association. (1) The Commission felt that a curriculum heavily weighted with courses in administration is inappropriate as a program for teachers. (2) A graduate program should, according to the Commission, involve work at a higher level than that characterizing undergraduate study and they would make a distinction between a graduate program leading to a master's degree and a program consisting simply of another year of study beyond the baccalaureate degree. (3) The Commission too observed that the master's degree level for teachers is usually terminal as distinguished from graduate work which is a step toward the doctor's degree. Teaching experience was felt to be desirable but not essential. Considerable emphasis was placed upon the importance of course work being actually graduate level.[17]

A sub-committee of the American Association for the Advancement of Science prepared recommendations for the preparation of high school teachers of science and mathematics. Included in the recommendations, in addition to those for the four year programs, are recommendations for the fifth year of teacher education in the science areas and in mathematics. While they point out the desirability of a flexible program, they propose certain topics which they feel would be beneficial to teachers in the different areas. They propose for the biology teacher

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[17]Commission on Colleges and Universities, "Programs of Post-Baccalaureate Study for Teachers," North Central Association Quarterly, XXXI, (July, 1956), pp. 29-31.

that at least 25 per cent of the course work be devoted to definite biological topics, such as radiation biology, microbiology, taxonomy, and training in microtechniques. In addition, such "cultural" courses in science as history of science and problems of the atomic age are suggested. The fifth year for the chemistry teacher should include advanced inorganic chemistry, biochemistry, and radiochemistry. No specific courses are proposed for the fifth year for the physics teacher; however fifteen hours of physics, ten hours of chemistry, and five hours of mathematics are suggested. They recommend further that at least half the fifth-year work be in science courses.[18] These recommendations contributed to the formulation of guidelines mentioned later.

James B. Conant calls for a flexible but more rigorous master's program for teachers, with more work in subject matter disciplines than many master's degree programs in teacher education have called for in the past. He suggests that for teachers in secondary schools who have been granted a teaching certificate in a subject matter field, approximately two-thirds of the time be spent in increasing competency in their special field, or in developing competency in another field. In designing an individuals master's program the institution should attempt to assure the adequacy of preparation in one or possibly two fields. The master's degree program might also include further work in psychology, the study of history and philosophy of education, and a seminar in methods. Conant feels that much of the work in methods and psychology can be really meaningful only after a person has had teaching experience

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[18]Report of the Sub-Committee on Teacher Certification, Alfred B. Garrett, Chairman, "Recommendations for the Preparation of High School Teachers of Science and Mathematics," School Science and Mathematics, LIX, (April, 1959), pp. 284-88.

in which he has met and struggled with the problems. He suggests, therefore, that the professional education courses on the undergraduate level be drastically reduced and that opportunities be provided in the graduate program for taking these courses.[19]

In December, 1958, a study concerned with the subject-matter preparation of secondary school teachers of mathematics and science was initiated by the National Association of State Directors of Teacher Education and Certification in cooperation with the American Association for the Advancement of Science. A series of conferences followed which resulted in the formulation of guidelines for the preparation of teachers of various science and mathematics subject areas reflecting the points of view of the participants. A set of common guidelines was developed, and a special recommendation was made regarding the fifth year. "A fifth-year program should emphasize courses in the subject taught."[20]

That guideline is then discussed with some specific suggestions in each of the areas: biology,[21] chemistry,[22] physics,[23] and physical science.[24] These two features of the recommendations are common to

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[19]James Bryant Conant, The Education of American Teachers (New York: McGraw-Hill Book Company, Inc., 1963), pp. 200-02.

[20]National Association of State Directors of Teacher Education and Certification and the American Association for the Advancement of Science, Guidelines for Preparation Programs of Teachers of Secondary School Science and Mathematics, Recommendations of the Teacher Preparation-Certification Study (Washington, D. C., NASDTEC--AAAS Studies, 1961), pp. 5-6.

[21]Ibid., pp. 8-9.

[22]Ibid., p. 12.

[23]Ibid., p. 15.

[24]Ibid., pp. 18-19.

the first three areas: (1) At least half of the advanced study beyond the baccalaureate should be devoted to courses in the subject matter area or, as in the case of physics, to science and mathematics. (2) Broadening courses in the history and philosophy of science, history and philosophy of education, the development of experiments and demonstration techniques, and research participation would be valuable adjuncts to the program. In the area of physical sciences, the fifth-year program should be devoted primarily to physics, chemistry, and mathematics with courses being chosen in each area.

Suggestions by individuals and by groups for the fifth year of teacher education have been reviewed. The desirability of strengthening subject matter areas is perhaps the most consistent point of agreement among these suggestions. Some general recommendations were presented and some more specific programs were reviewed. The study by Boyd, however, is the only one found concerned specifically with opinions of a sample of science teachers. With these facts in mind, this study was proposed. A mailed questionnaire was used to obtain opinions concerning the fifth year of teacher education from secondary school science teachers of Oklahoma who have completed a master's degree program. In addition, school administrators who employ teachers were sampled and their opinions obtained in the same manner.

## CHAPTER III

## METHODS AND PROCEDURES

Preliminary to the formulation of an instrument to be used in the study, literature pertaining to the construction and utilization of questionnaires was reviewed. The questionnaire used by Boyd[1] was examined, and using it as a guide, questionnaires to be used in this research were constructed. Throughout the composition of the questionnaires, suggestions from people concerned with the education of science teachers were sought and utilized. The outcome was the questionnaire to be used with the high school science teachers (Appendix IV) and a modified form of the same questionnaire for school administrators (Appendix V). The questionnaire for administrators differed from that for teachers only in Part One, the personal data sheet, and in Group IV of Part Three where administrators were asked to list desirable courses for teachers of several different teaching combinations. A preliminary study which is discussed later was conducted to test the effectiveness of the questionnaires.

Part One of the questionnaires was designed to provide information regarding the character of the samples mainly with respect to education and experience. The responses to each of the items of this

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[1]Boyd, pp. 85-91.

part of the questionnaires were tallied and the percentage responding to each item was calculated.

Information from Part Two of the questionnaires was tabulated and analyzed to obtain a basis for recommendations relative to the graduate education of secondary school science teachers. In items one through twenty-nine of Part Two the respondent was asked to answer each of the items from two frames of reference--first on the basis of his experience with the item in his graduate education and secondly on the basis of his recommendations for a graduate program. If the respondent felt that in his graduate experience the item was of high value, he was to check column one. If the item was of moderate value, column two, if undecided as to its value, column three, if of little value, column four, if of no value, column five, and if he had had no experience with the item in his graduate program, he was to check column six.

Each respondent was also asked to check each item on the basis of his recommendations for the fifth-year program for teachers. In this case, he was to check column one if he agreed completely with the item. He was to check column two if he tended to agree, column three, if he was undecided, column four, if he tended to disagree, and column five, if he disagreed completely.

In order to obtain a consensus to an item which could be compared and ranked relative to responses to other items for the purpose of analysis, a measure of central tendency of responses was necessary. An arithmetical mean of the responses to each item was determined. To facilitate the determination of a mean value for the responses to each item, a value was assigned to each response. A value of one was assigned

to a response in column one, two to a response in column two, three to a response in column three, four to a response in column four, and five to a response in column five. Column six under the category "Experience" was not assigned a value since it denoted "No Experience" with the item. To obtain a mean ranking response index for an item, the frequency of responses to an item checked in column one was multiplied by one, the frequency of responses to the item checked in column two was multiplied by two, frequency of responses in column three was multiplied by three, frequency of responses in column four was multiplied by four, and frequency of responses in column five was multiplied by five. These products in each of the five columns were added for an item and the sum was divided by the number of responses to the item. A mean ranking response index was obtained for each item in this manner. Therefore, a ranking response index of 1.00 would indicate a "High Value" under "Experience" or "Agree Completely" under "Recommendations." In either case, a ranking index of 1.00 would indicate complete agreement by all the teachers or administrators responding. A ranking index of 5.00 would indicate that all the respondents checked "Of No Value," or "Disagree Completely."

For analytical purposes, a ranking index of 2.49 or less was selected as indicating conclusive value or agreement with the item, while a ranking index of 3.51 or greater was selected as indicating conclusive lack of value or disagreement with the item. These values were selected since any combination of two responses less favorable than one, agree completely, and three, undecided, gives a ranking index of 2.50 or greater. The same reasoning applies to the use of a value 3.51

or greater for conclusive disagreement. An index of 2.50 to 3.00 denotes inconclusive agreement and 3.00 to 3.50 denotes inconclusive disagreement with an item.

The responses under "Recommendations" to this portion of the questionnaire for teachers were tabulated and analyzed as indicated above. A teacher's experience and the amount of graduate science education completed might affect his recommendation relative to an item; therefore, the responses to the items were also tabulated and analyzed with respect to: (1) graduate experience with the item, (2) years of teaching experience, and (3) number of semester hours of graduate science completed.

Questionnaire items thirty and thirty-one of Part Two deal with the percentage of the total fifth-year program to be devoted to various areas. The responses in each of the areas were tabulated and the mean determined. Since it is possible that a person's responses would be affected by the number of different courses taught, items thirty and thirty-one of the teacher's questionnaire were analyzed on the basis of responses of teachers teaching a single course, those teaching two different courses, and those teaching more than two different courses or general science.

Items thirty-two and thirty-three, dealing with the teaching of advanced methods courses, were reported as number of responses and as percentages. Item thirty-four, dealing with the need for change at the college level to better prepare the high school teacher for new science programs, was reported in the same manner. These items were considered in respect to the number of years teaching experience of the science

teachers to see if there was any marked difference in the responses of these groups of teachers.

Responses to Part Three of the questionnaires, dealing with course offerings, were tabulated and the courses were ranked by employing ranking indices. The responses of teachers to this section were analyzed in relation to the number of years of teaching experience, number of semester hours of graduate science completed, and whether or not the course had been taken by the respondents.

In Part Four of the questionnaires the respondents were asked to rank the areas or groups of courses referred to in Part Three. A mean rank was determined for each area and the areas were ranked. The responses of the teachers in ranking the areas were considered with respect to the number of years teaching experience and the number of semester hours of graduate science completed.

## Preliminary Study

Using a sample of science teachers and administrators obtained from educational directories, a preliminary study was conducted. This preliminary study was made in order to ascertain whether or not data could be gathered by mailed questionnaires which would be usable in answering the question being investigated. Thirty-four science teachers in secondary schools of Oklahoma who had completed the master's degree constituted the teacher population for the preliminary study. Fourteen superintendents were sent the administrator's questionnaire. Thirty-two (94.12 per cent) of the teachers and ten (71.43 per cent) of the administrators returned completed usable questionnaires. The excellent response to the questionnaires indicated that a satisfactory return could

be expected in this study. Also, there were no observed discrepancies in responses to the items of the questionnaires; that finding indicated that the items were being understood by the population sampled in the preliminary study.

## The Population

The population of the study consisted of 267 secondary school science teachers of Oklahoma high schools who have completed a master's degree program and 80 administrators (Five were principals in large city school systems and 75 were superintendents.) of Oklahoma high schools.

The list of science teachers holding a master's degree was obtained from the principals of high schools in Oklahoma, personnel directors, county educational directories, and personal contact. Each principal was sent a postage-paid return card requesting this information concerning teachers in his school (Appendix I). Information was obtained from 422 of the high schools of Oklahoma. The principals of 205 of these schools indicated they have science teachers on their staff who hold the master's degree. These 205 high schools provided the sample of 324 secondary school science teachers, including the 34 in the preliminary study. A stratified random sample of administrators was used. The basis of stratification was school size using the categories of the Oklahoma Secondary School Activities Association. Proportionate random samples were selected from each school size category using a table of random numbers. Class AAA and class AA schools each make up about 6 per cent of the high schools in Oklahoma; therefore, six high schools were selected from each of these categories. High schools in classes A, B, and C make up about 24 per cent, 22 per cent, and 42 per cent of the

high schools; therefore, twenty-four high schools were selected from class A, twenty-two from class B, and forty-two from class C. One hundred administrators--in addition to the fourteen selected in the preliminary study--were selected in this manner.

## Method of Obtaining Data

Each of the 324 secondary school science teachers holding a master's degree and the 114 administrators, selected from Oklahoma high schools, was sent a questionnaire, a letter of explanation (Appendices II and III), and a postage-paid return envelope. Approximately three weeks after the questionnaires were mailed, a reminder postal card was mailed to the non-respondents. A new questionnaire was mailed to the remaining non-respondents about two weeks after the first reminders were mailed.

Approximately 55 per cent of the total returned questionnaires from Oklahoma high school science teachers and about 60 per cent of the total returns from administrators of Oklahoma high schools were received prior to the mailing of the first reminder. A total of 267 usable questionnaires was received from Oklahoma high school science teachers who had completed a master's degree program. This total represents a return of 82.41 per cent from the 324 Oklahoma high school science teachers who were mailed questionnaires. A total of eighty usable questionnaires was received from administrators of Oklahoma high schools. This number represents a return of 70.18 per cent of the 114 questionnaires mailed school administrators.

# CHAPTER IV

## CHARACTER OF THE SAMPLE

The original teacher sample for this study was composed of 324 high school science teachers of Oklahoma high schools who had been identified by their principals as having completed a master's degree program. The teachers in the sample were mailed questionnaires with explanatory letters and stamped return envelopes. The 267 science teachers who returned usable, completed questionnaires provided the data from teachers for this study. These teachers, each of whom held a master's degree, represented a return of 82.41 per cent.

The information from the data sheets which accompanied each teacher's questionnaire is shown in Table 1. The response was unevenly divided as to sex: 84.27 per cent male to 15.73 per cent female. The experience of the teachers in the sample will be found in item two of Table 1. Those data show that more than half, 56.55 per cent, of the teachers had taught more than ten years.

The data in item three of Table 1 indicate that many of the teachers taught more than one course. The most frequently listed subject was biology, with 68.16 per cent of the teachers indicating it to be one of the courses they taught; followed by chemistry, with 51.31 per cent; and physics, with 30.34 per cent. More than half the teachers, 56.93 per cent, indicated they taught other science in addition to biology, chemistry, physics, and earth science.

TABLE 1.--Data Concerning Science Teachers

| Number | Question | Number Responding | Percentage[a] |
|---|---|---|---|
| 1. | Sex: | | |
| | Male | 225 | 84.27 |
| | Female | 42 | 15.73 |
| 2. | Number of years teaching experience: | | |
| | 1 to 3 years | 11 | 4.12 |
| | 4 to 6 years | 36 | 13.48 |
| | 7 to 10 years | 69 | 25.84 |
| | More than 10 years | 151 | 56.55 |
| 3. | Courses taught: | | |
| | Biology | 182 | 68.16 |
| | Chemistry | 137 | 51.31 |
| | Physics | 81 | 30.34 |
| | Earth Science | 45 | 16.85 |
| | Other Science | 152 | 56.93 |
| | General Science | 96 | 35.96 |
| | Physical Science | 29 | 10.86 |
| | Other | 55 | 20.60 |
| | Mathematics | 34 | 12.73 |
| 4. | Type of school: | | |
| | Four year high school | 82 | 30.71 |
| | Three year high school | 107 | 40.07 |
| | Six year junior-senior high school | 74 | 27.72 |
| | Other (Junior College) | 2 | 0.75 |
| 5. | High School enrollment in grades 10-12: | | |
| | 0-99 | 51 | 19.10 |
| | 100-499 | 119 | 44.57 |
| | 500-999 | 40 | 14.98 |
| | 1,000-up | 57 | 21.35 |
| 6. | State in which degrees obtained: | | |
| | Baccalaureate: | | |
| | Oklahoma | 236 | 88.39 |
| | Other | 28 | 10.49 |
| | Highest degree: | | |
| | Oklahoma | 212 | 79.40 |
| | Other | 50 | 18.73 |
| 7. | Teaching plans: | | |
| | Only a few years | 20 | 7.49 |
| | Permanent career | 196 | 73.41 |
| | Undecided | 50 | 18.73 |

TABLE 1.--Continued

| Number | Question | Number Responding | Percentage[a] |
|---|---|---|---|
| 8. | Number of semester hours of undergraduate science during undergraduate work: | | |
| | Biology: | | |
| | None | 5 | 1.87 |
| | 1-10 | 45 | 16.85 |
| | 11-20 | 69 | 25.84 |
| | 21-30 | 72 | 26.97 |
| | 31-40 | 46 | 17.23 |
| | Over 40 | 29 | 10.86 |
| | Chemistry: | | |
| | None | 22 | 8.24 |
| | 1-10 | 102 | 38.20 |
| | 11-20 | 83 | 31.09 |
| | 21-30 | 37 | 13.86 |
| | 31-40 | 15 | 5.62 |
| | Over 40 | 7 | 2.62 |
| | Physics: | | |
| | None | 40 | 14.98 |
| | 1-10 | 142 | 53.18 |
| | 11-20 | 69 | 25.84 |
| | 21-30 | 10 | 3.75 |
| | 31-40 | 4 | 1.50 |
| | Over 40 | 1 | 0.37 |
| | Other: | | |
| | None | 198 | 74.16 |
| | 1-10 | 41 | 15.36 |
| | Geology and earth science | 31 | 11.61 |
| | 11-20 | 16 | 5.99 |
| | Geology and earth science | 13 | 4.87 |
| | 21-30 | 3 | 1.12 |
| | 31-40 | 5 | 1.87 |
| | Over 40 | 3 | 1.12 |
| 9. | Number of semester hours of science taken since completion of the baccalaureate degree: | | |
| | Biology: | | |
| | None | 69 | 25.84 |
| | 1-10 | 78 | 29.21 |
| | 11-20 | 62 | 23.22 |
| | 21-30 | 31 | 11.61 |
| | 31-40 | 17 | 6.37 |
| | Over 40 | 10 | 3.75 |

TABLE 1.--Continued

| Number | Question | Number Responding | Percentage[a] |
|---|---|---|---|
| | Chemistry: | | |
| | None | 102 | 38.20 |
| | 1-10 | 107 | 40.07 |
| | 11-20 | 39 | 14.61 |
| | 21-30 | 13 | 4.87 |
| | 31-40 | 6 | 2.25 |
| | Over 40 | 0 | 0.00 |
| | Physics: | | |
| | None | 136 | 50.94 |
| | 1-10 | 95 | 35.58 |
| | 11-20 | 31 | 11.61 |
| | 21-30 | 5 | 1.87 |
| | 31-40 | 0 | 0.00 |
| | Over 40 | 0 | 0.00 |
| | Other: | | |
| | None | 211 | 79.03 |
| | 1-10 | 43 | 16.10 |
| | Geology and earth science | 34 | 12.73 |
| | 11-20 | 9 | 3.37 |
| | Geology and earth science | 7 | 2.62 |
| | 21-30 | 3 | 1.12 |
| | 31-40 | 1 | 0.37 |
| | Over 40 | 0 | 0.00 |
| 10. | Semester hours of graduate science: | | |
| | Biology: | | |
| | None | 97 | 36.33 |
| | 1-10 | 80 | 29.96 |
| | 11-20 | 43 | 16.10 |
| | 21-30 | 25 | 9.36 |
| | 31-40 | 17 | 6.37 |
| | Over 40 | 4 | 1.50 |
| | Chemistry: | | |
| | None | 139 | 52.06 |
| | 1-10 | 90 | 33.71 |
| | 11-20 | 27 | 10.11 |
| | 21-30 | 9 | 3.37 |
| | 31-40 | 1 | 0.37 |
| | Over 40 | 0 | 0.00 |
| | Physics: | | |
| | None | 183 | 68.54 |
| | 1-10 | 67 | 25.09 |
| | 11-20 | 15 | 5.62 |
| | 21-30 | 1 | 0.37 |
| | 31-40 | 0 | 0.00 |
| | Over 40 | 0 | 0.00 |

TABLE 1.--Continued

| Number | Question | Number Responding | Percentage[a] |
|---|---|---|---|
| | Other: | | |
| | None | 233 | 87.27 |
| | 1-10 | 27 | 10.11 |
| | Geology and earth science | 20 | 7.49 |
| | 11-20 | 4 | 1.50 |
| | 21-30 | 2 | 0.75 |
| | 31-40 | 0 | 0.00 |
| | Over 40 | 0 | 0.00 |
| 11. | Type of undergraduate degree: | | |
| | Bachelor of Arts with major or minor in science | 44 | 16.48 |
| | Bachelor of Science with major or minor in science | 115 | 43.07 |
| | Bachelor of Science in Education with major or minor in science | 108 | 40.45 |
| | Other | 12 | 4.49 |
| 12. | Institution at which undergraduate degree completed: | | |
| | Type of institution: | | |
| | State University | 81 | 30.34 |
| | State College | 163 | 68.78 |
| | Privately endowed University or College | 26 | 9.74 |
| | Enrollment of institution: | | |
| | Less than 500 | 1 | 0.37 |
| | 500 to 2,499 | 136 | 50.94 |
| | 2,500 to 5,000 | 62 | 23.22 |
| | Over 5,000 | 67 | 25.09 |
| 13. | Type of advanced degree completed or in the process of completing: | | |
| | Master's in science with no education courses | 59 | 22.10 |
| | Master's in education with a major or minor in science | 53 | 19.85 |
| | Master's in education with no science courses | 61 | 22.85 |
| | Master of teaching degree with science concentration | 71 | 26.59 |
| | Doctorate | 10 | 3.75 |
| | Other (Master's--primarily science and some education) | 25 | 9.36 |

TABLE 1.--Continued

| Number | Question | Number Responding | Percentage[a] |
|---|---|---|---|
| 14. | Date advanced degree granted: | | |
| | Master's: | | |
| | Before 1950 | 28 | 10.48 |
| | 1950-59 | 81 | 30.34 |
| | 1960-Present | 134 | 50.19 |
| | Doctorate: | 0 | 0.00 |
| 15. | Institution at which work on master's degree was taken: | | |
| | Type of institution: | | |
| | State University | 165 | 61.80 |
| | State College | 95 | 35.58 |
| | Privately endowed University or College | 16 | 5.99 |
| | Enrollment of institution: | | |
| | Less than 500 | 0 | 0.00 |
| | 500 to 2,499 | 50 | 18.73 |
| | 2,500 to 5,000 | 66 | 24.72 |
| | Over 5,000 | 153 | 57.30 |
| 16. | Institution at which work on doctorate was taken: | | |
| | Type of institution: | | |
| | State University | 38 | 14.23 |
| | State College | 6 | 2.25 |
| | Privately endowed University or College | 11 | 4.12 |
| | Enrollment of institution: | | |
| | Less than 500 | 0 | 0.00 |
| | 500 to 2,499 | 4 | 1.50 |
| | 2,500 to 5,000 | 9 | 3.37 |
| | Over 5,000 | 42 | 15.73 |

[a]Percentages based on 267

The number of different courses taught by individual teachers is shown in Table 2. Those data show that 24.34 per cent of the teachers responding taught a single science area exclusively, while 60.29 per cent indicated they taught more than two subject areas, including science and non-science combinations, or general science.

TABLE 2.--Number of Different Courses Taught by Individual Teachers

| Subject Areas Taught | Number Responding | Percentage[a] |
|---|---|---|
| One Science Area | 65 | 24.34 |
| Biology | 44 | 16.48 |
| Chemistry | 15 | 5.62 |
| Physics | 3 | 1.12 |
| Other | 3 | 1.12 |
| Two Science Areas | 27 | 10.11 |
| One Science and One Other | 14 | 5.24 |
| More than Two Areas and/or General Science | 161 | 60.29 |

[a]Percentages based on 267

The type of school in which the respondents taught and the high school enrollment are presented in items four and five of Table 1. The most frequently listed school type was the three year high school, checked by 40.07 per cent of the teachers. The data show that the largest number of teachers (44.57 per cent) taught in schools with from 100 to 499 students in grades ten through twelve. This is more than twice the number in any of the other enrollment categories; however, 21.35 per cent taught in schools with 1,000 or more students in those grades and 19.10 per cent taught in high schools with fewer than 100 students in the top three grades.

The majority of the respondents received their higher education in Oklahoma. Of the respondents, 88.39 per cent received the baccalaureate and 79.40 per cent their highest degree from Oklahoma universities and colleges. Approximately three-fourths (73.41 per cent) of the teachers had decided on teaching as a permanent career. The future occupational plans of 18.73 per cent of the responding teachers were

uncertain and 7.49 per cent planned to teach only a few years.

The undergraduate science education of the teachers responding was quite diverse; though biology was apparently the favored area. The number of semester hours taken in different areas will be found in item eight of Table 1. Those data show that approximately 28 per cent of the teachers had taken more than thirty hours of undergraduate biology; 8.24 per cent had taken more than thirty hours of chemistry as an undergraduate; and 1.87 per cent had taken more than thirty hours of physics. Data found in item nine show a similar pattern in the post-baccalaureate science education of the respondents. Those data show 10.12 per cent of the teachers having taken more than thirty hours of biology since completing the bachelor's degree while 2.25 per cent had taken over thirty hours of chemistry. None indicated as much work in physics.

A substantial amount of the post-graduate work shown in item nine was graduate college work with the distribution among the science areas similar to that found previously. The data in item ten, Table 1 show twenty-one (7.87 per cent) teachers had taken more than thirty semester hours of graduate biology and one teacher had taken more than thirty hours of graduate chemistry. One-third of the teachers responding had taken more than ten hours of graduate biology, 13.85 per cent had taken more than ten hours of graduate chemistry, and 5.99 per cent had taken more than ten hours of graduate physics.

The types of degrees earned by the teachers in the sample and the types of institutions attended will also be found in Table 1. Some teachers had taken two bachelor's degrees and others two master's. The data show that 43.07 per cent had taken the bachelor of science with a

major or minor in science and 40.45 per cent of the teachers had taken the bachelor of science in education degree with a major or minor in science. The majority of the baccalaureate degrees, 68.78 per cent, were awarded by state colleges. The data of item thirteen show a fairly even distribution among the different master's degrees. The master of teaching degree with a science concentration was most often indicated. That degree was taken by 26.59 per cent of the teachers, while 22.10 per cent took the master's in science with no education courses, and 22.85 per cent took the master's in education with no science courses. The doctorate was being pursued by 3.75 per cent of the teachers. About half (50.19 per cent) of the teachers had been awarded the master's degree after 1959. More than half (61.80 per cent) of the master's degrees were awarded by a state university.

The administrator sample for this study was composed of superintendents and principals of Oklahoma high schools who were in positions requiring them to make judgments regarding the qualifications of teachers they employ. The original sample of administrators was obtained by first stratifying all high schools in Oklahoma on the basis of school size using the categories of the Oklahoma Secondary School Activities Association. A proportionate random sample, using a table of random numbers, was taken from each of the five school categories obtained above. One hundred schools selected in this manner plus the fourteen schools used in the preliminary study gave an original sample of 114 schools. The names of the administrators of the schools (six were principals of high schools in larger city school systems and 108 were superintendents) were obtained from the Oklahoma Educational Directory and

each was mailed a questionnaire with an explanatory letter and a stamped return envelope. The eighty administrators who returned usable questionnaires constituted a 70.18 per cent return and provided the information from school administrators for this study.

The information from the data sheet which accompanied each questionnaire to the administrators is shown in Table 3. Those data show that more than ten years experience was indicated by 51.25 per cent of the administrators responding. Data in item two show that 43.75 per cent of the administrators were in charge of schools with 100 to 299 students enrolled in grades ten through twelve and 33.75 per cent were in charge of schools with fewer than 100 students in those three grades. Over half (52.50 per cent) of the administrators had more than ten years classroom teaching experience.

Teaching fields listed by the administrators in the sample will be found in item four of Table 3. As the data indicate, most of the administrators listed more than one teaching field. The most popular teaching field listed was social studies with 62.50 per cent of the administrators checking that area. Following social studies were mathematics and science with 42.50 per cent and 40.00 per cent of the administrators indicating those teaching fields.

The education of the administrators in the sample will also be found in Table 1. Those data show that 45.00 per cent of the administrators had taken twenty or more hours of undergraduate science; however, 75.00 per cent of them had taken no graduate science. It can be seen that two administrators had taken over forty hours of graduate science and two had taken from twenty to twenty-nine hours.

TABLE 3.--Data Concerning Public School Administrators

| Number | Question | Number Responding | Percentage[a] |
|---|---|---|---|
| 1. | Number of years of experience as superintendent (principal): | | |
| | 1 to 3 years | 14 | 17.50 |
| | 4 to 6 years | 13 | 16.25 |
| | 7 to 10 years | 12 | 15.00 |
| | More than 10 years | 41 | 51.25 |
| 2. | Enrollment of high school (grades 10-12): | | |
| | Less than 100 | 27 | 33.75 |
| | 100 to 299 | 35 | 43.75 |
| | 300 to 499 | 8 | 10.00 |
| | 500 to 699 | 3 | 3.75 |
| | 700 to 1,000 | 3 | 3.75 |
| | Over 1,000 | 4 | 5.00 |
| 3. | Number of years classroom teaching experience: | | |
| | 1 to 3 years | 5 | 6.25 |
| | 4 to 6 years | 16 | 20.00 |
| | 7 to 10 years | 17 | 21.25 |
| | More than 10 years | 42 | 52.50 |
| 4. | Teaching fields: | | |
| | Business Education | 16 | 20.00 |
| | Science | 32 | 40.00 |
| | Language Arts | 15 | 18.75 |
| | Physical Education | 11 | 13.75 |
| | Industrial Arts | 6 | 7.50 |
| | Mathematics | 34 | 42.50 |
| | Social Studies | 50 | 62.50 |
| | Other | 13 | 16.25 |
| 5. | Number of hours of science taken: | | |
| | Undergraduate: | | |
| | None | 1 | 1.25 |
| | 1 to 9 hours | 18 | 22.50 |
| | 10 to 19 hours | 24 | 30.00 |
| | 20 to 29 hours | 19 | 23.75 |
| | 30 to 40 hours | 6 | 7.50 |
| | Over 40 hours | 11 | 13.75 |
| | Graduate: | | |
| | None | 60 | 75.00 |
| | 1 to 9 hours | 7 | 8.75 |
| | 10 to 19 hours | 5 | 6.25 |
| | 20 to 29 hours | 2 | 2.50 |
| | 30 to 40 hours | 0 | 0.00 |
| | Over 40 hours | 2 | 2.50 |

TABLE 3.--Continued

| Number | Question | Number Responding | Percentage[a] |
|---|---|---|---|
| 6. | Highest degree completed: | | |
| | Bachelor's | 3 | 3.75 |
| | Master's | 70 | 87.50 |
| | Doctorate | 4 | 5.00 |
| | Major: | | |
| | Education and Administration | 59 | 73.75 |
| | Other | 18 | 22.50 |
| 7. | Institution at which work on master's degree was taken: | | |
| | Type of institution: | | |
| | State University | 61 | 76.25 |
| | State College | 16 | 20.00 |
| | Privately Endowed University or College | 9 | 11.25 |
| | Enrollment of institution: | | |
| | Less than 500 | 0 | 0.00 |
| | 500 to 2,499 | 15 | 18.75 |
| | 2,500 to 5,000 | 8 | 10.00 |
| | Over 5,000 | 60 | 75.00 |
| 8. | Institution at which work was taken on doctorate: | | |
| | Type of institution: | | |
| | State University | 45 | 56.25 |
| | State College | 3 | 3.75 |
| | Privately Endowed University or College | 6 | 7.50 |
| | Enrollment of institution: | | |
| | Less than 500 | 0 | 0.00 |
| | 500 to 2,499 | 1 | 1.25 |
| | 2,500 to 5,000 | 3 | 3.75 |
| | Over 5,000 | 49 | 61.25 |

[a]Percentages based on 80.

The bachelor's degree was the highest degree completed by 3.75 per cent of the administrators who responded; 87.50 per cent had completed the master's degree; and 5.00 per cent had completed the doctorate. Education and administration was the most frequently listed major with 73.75 per cent; 22.50 per cent listed other majors.

The data show most of the administrators did their graduate work on the master's at state universities, 76.25 per cent so indicating; 20.00 per cent listed work at state colleges; and 11.25 per cent did work at privately endowed institutions. Three-fourths of them did work at institutions of over 5,000 enrollment. Work on the doctorate had been taken at state universities by 56.25 per cent of the administrators, at state colleges by 3.75 per cent, and at privately endowed universities and colleges by 7.50 per cent. Most of the administrators took the work at institutions with over 5,000 students enrolled.

## Summary

The response of both teachers and school administrators to the invitation to participate in this study was most gratifying since 82.41 per cent of the teachers and 70.18 per cent of the administrators returned usable questionnaires. The excellent return by both administrators and teachers supported the assumption that the desired information could be obtained in this manner. That the respondents were qualified to provide opinions on the requirements for the fifth year of graduate education for science teachers was evidenced in several ways. With respect to experience, 82.39 per cent of the teachers and 66.25 per cent of the administrators had more than six years experience in their occupations. In addition, 73.75 per cent of the administrators had more than six years classroom teaching experience. The master's degree had been completed by all the science teachers and 87.50 per cent of the administrators had completed the master's as their highest degree plus another 5.00 per cent who had completed doctorates. Almost half the administrators had more than twenty hours of undergraduate science and

20.00 per cent of them had some graduate science. The responses from teachers revealed that more than 41.00 per cent of them had over thirty semester hours of undergraduate science in a single area. In their graduate work, more than 21.00 per cent of the teachers had over twenty semester hours of graduate science in a single area; more than 25.00 per cent had a total of over thirty semester hours of graduate science; and more than 49.00 per cent of the teachers had over twenty semester hours of graduate science.

# CHAPTER V

## GENERAL FINDINGS OF STUDY

Teachers and administrators who participated in this study were asked to respond to twenty-nine statements in Part Two[1] of the questionnaire concerning the fifth year of teacher education for teachers of high school science. Each respondent was asked to answer each of the items from two frames of reference--first on the basis of his experience with the item in his graduate education and secondly on the basis of his recommendations for a graduate program. The statements were arranged so that the respondent had only to check the appropriately headed column to indicate the value of the item in his graduate experience or the extent of agreement with the item as a recommendation for a graduate program for high school science teachers. Responses to items thirty and thirty-one dealt with the percentage of the total fifth-year program to be devoted to various areas while items thirty-two and thirty-three were concerned with the teaching of advanced methods courses. The final item of this part of the questionnaire dealt with the need for change at the college level to better prepare the high school teacher for new programs in high school science. Respondents were asked to rank courses in Part Three that might be offered in a graduate program and in Part Four

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[1]Part One was personal data.

they were asked to rank groups of courses from Part Three of the questionnaire.

## Analysis of Opinions of Science Teachers Concerning Statements 1-29 of Part Two

The responses of science teachers concerning their experience with items one through twenty-nine are presented in Table 4. These responses were made relative to the value the teacher placed on the item in his graduate experience. The total response to each item, the number responding in each category, the percentage reporting no graduate experience with the item, the ranking index of each item, and the rank according to the ranking index are shown.

Responses of the science teachers to the same items concerning their recommendations relative to the graduate education of the high school science teacher are presented in Tables 5 and 6. Data from the tables are graphically presented by Graphs 1, 2, and 3 immediately following Table 6. The responses of teachers were analyzed on the basis of graduate experience with the item, teaching experience, and amount of graduate science completed. The total response to each item, the number of responses in each category, the ranking index for all teachers responding, the rank of each statement based on the ranking index for all teachers, the ranking index for teachers indicating no graduate experience with the statement, and the ranking index for teachers indicating graduate experience with the statement are presented in Table 5. The ranking indices presented in Table 6 are separated into five categories: those for responses of teachers with one to six years teaching experience, those for responses of teachers with seven or more years teaching experience,

TABLE 4.--Responses of Science Teachers to Part Two Concerning Their Experience with Items 1 through 29 with Ranking Indices to Show the Rank of the Item

| | Number of Responses | High Value | Moderate Value | Undecided | Little Value | Of No Value | No Experience with Item | Percentage Reporting No Experience with Item | Ranking Index Graduate Experience with Item | Rank According to Index |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Cultural courses | 266 | 57 | 81 | 12 | 37 | 4 | 75 | 28.20 | 2.21 | 19 |
| 2. In-service credit | 267 | 69 | 69 | 14 | 15 | 0 | 100 | 37.45 | 1.85 | 9 |
| 3. Course in administration | 264 | 60 | 57 | 14 | 33 | 17 | 83 | 31.44 | 2.39 | 22 |
| 4. Workshop combining scientific disciplines | 263 | 71 | 66 | 21 | 17 | 5 | 83 | 31.56 | 1.99 | 13 |
| 5. Thesis | 264 | 43 | 53 | 16 | 56 | 25 | 71 | 26.89 | 2.83 | 28 |
| 6. Formal science courses | 265 | 73 | 89 | 19 | 27 | 18 | 39 | 14.72 | 2.24 | 21 |
| 7. Consumers of science research | 262 | 63 | 83 | 27 | 23 | 12 | 54 | 20.61 | 2.22 | 20 |
| 8. Consumers of education research | 259 | 44 | 90 | 34 | 32 | 16 | 43 | 16.60 | 2.47 | 25 |
| 9. Graduate practice teaching | 266 | 43 | 39 | 20 | 20 | 13 | 131 | 49.25 | 2.41 | 23 |
| 10. Laboratory facilities | 265 | 160 | 49 | 1 | 8 | 2 | 45 | 16.98 | 1.38 | 2 |
| 11. Laboratory schools | 266 | 88 | 51 | 11 | 11 | 2 | 103 | 38.72 | 1.70 | 6 |
| 12. Flexible program | 265 | 94 | 57 | 22 | 21 | 8 | 63 | 23.77 | 1.97 | 12 |
| 13. Require science education research | 265 | 32 | 44 | 27 | 41 | 16 | 105 | 39.62 | 2.78 | 27 |

TABLE 4.--Continued

| | Number of Responses | High Value | Moderate Value | Undecided | Little Value | Of No Value | No Experience with Item | Percentage Reporting No Experience with Item | Ranking Index Graduate Experience with Item | Rank According to Index |
|---|---|---|---|---|---|---|---|---|---|---|
| 14. Demonstrations in college classes | 264 | 136 | 66 | 6 | 8 | 3 | 45 | 17.05 | 1.52 | 3 |
| 15. Elective science education research | 259 | 57 | 61 | 15 | 12 | 4 | 110 | 42.47 | 1.96 | 11 |
| 16. Encourage teaching experience | 262 | 137 | 31 | 18 | 14 | 7 | 55 | 20.99 | 1.66 | 5 |
| 17. Require teaching experience | 227 | 80 | 27 | 29 | 7 | 12 | 72 | 31.72 | 1.99 | 13 |
| 18. Inquiry approach | 257 | 84 | 56 | 22 | 7 | 4 | 84 | 32.68 | 1.79 | 8 |
| 19. Elective research in science | 255 | 59 | 56 | 33 | 13 | 3 | 91 | 35.69 | 2.05 | 16 |
| 20. Terminal program | 261 | 39 | 32 | 59 | 19 | 13 | 99 | 37.93 | 2.60 | 26 |
| 21. Enable pursuit of doctorate | 256 | 57 | 47 | 41 | 12 | 3 | 96 | 37.50 | 2.11 | 17 |
| 22. History &/or philosophy of science | 262 | 71 | 67 | 9 | 26 | 11 | 78 | 29.77 | 2.13 | 18 |
| 23. Without awarding master's degree | 261 | 16 | 12 | 40 | 23 | 50 | 120 | 45.98 | 3.56 | 29 |
| 24. Specially designed advanced science courses | 266 | 154 | 47 | 7 | 4 | 1 | 53 | 19.92 | 1.36 | 1 |

TABLE 4.--Continued

| | Number of Responses | High Value | Moderate Value | Undecided | Little Value | Of No Value | No Experience with Item | Percentage Reporting No Experience with Item | Ranking Index Graduate Experience with Item | Rank According to Index |
|---|---|---|---|---|---|---|---|---|---|---|
| 25. Graduate introductory science courses | 262 | 110 | 52 | 18 | 10 | 7 | 65 | 24.81 | 1.74 | 7 |
| 26. Mathematics requirement | 264 | 95 | 39 | 23 | 18 | 14 | 75 | 28.41 | 2.03 | 15 |
| 27. Calculus for physical science | 265 | 50 | 42 | 34 | 25 | 14 | 100 | 37.74 | 2.46 | 24 |
| 28. Ten hours in each area | 265 | 136 | 55 | 15 | 9 | 5 | 45 | 16.98 | 1.60 | 4 |
| 29. Institute type program | 265 | 75 | 52 | 37 | 6 | 5 | 90 | 33.96 | 1.94 | 10 |

TABLE 5.--Responses of Science Teachers to Part Two Concerning Their Recommendations Relative to Items 1 through 29 with Ranking Indices

| | Number of Responses | Agree Completely | Tend to Agree | Undecided | Tend to Disagree | Disagree Completely | Ranking Index for all Teachers | Rank According to Index for all Teachers | Ranking Index No Graduate Experience with Item | Ranking Index Graduate Experience with Item |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Cultural courses | 263 | 80 | 100 | 28 | 42 | 13 | 2.27 | 19 | 2.70 | 2.11 |
| 2. In-service credit | 262 | 114 | 100 | 32 | 13 | 3 | 1.82 | 8 | 2.00 | 1.71 |
| 3. Courses in administration | 261 | 86 | 72 | 35 | 43 | 25 | 2.42 | 23 | 2.84 | 2.22 |
| 4. Workshops combining science disciplines | 259 | 118 | 88 | 36 | 13 | 4 | 1.83 | 10 | 1.81 | 1.84 |
| 5. Thesis | 261 | 51 | 49 | 48 | 75 | 38 | 3.00 | 28 | 3.46 | 2.83 |
| 6. Formal science courses | 262 | 90 | 80 | 28 | 40 | 24 | 2.34 | 22 | 2.87 | 2.25 |
| 7. Consumers of science research | 258 | 93 | 96 | 38 | 24 | 7 | 2.05 | 15 | 2.28 | 2.00 |
| 8. Consumers of education research | 256 | 67 | 101 | 45 | 27 | 16 | 2.31 | 20 | 2.80 | 2.22 |
| 9. Graduate practice teaching | 265 | 76 | 67 | 60 | 43 | 19 | 2.48 | 24 | 2.67 | 2.31 |
| 10. Laboratory facilities | 264 | 214 | 43 | 3 | 4 | 0 | 1.23 | 1 | 1.31 | 1.21 |
| 11. Laboratory schools | 260 | 140 | 80 | 26 | 11 | 3 | 1.68 | 4 | 1.78 | 1.62 |
| 12. Flexible program | 263 | 125 | 66 | 23 | 31 | 18 | 2.05 | 15 | 2.52 | 1.91 |

TABLE 5.--Continued

| | Number of Responses | Agree Completely | Tend to Agree | Undecided | Tend to Disagree | Disagree Completely | Ranking Index for all Teachers | Rank According to Index for all Teachers | Ranking Index No Graduate Experience with Item | Ranking Index Graduate Experience with Item |
|---|---|---|---|---|---|---|---|---|---|---|
| 13. Require science education research | 261 | 46 | 66 | 53 | 71 | 25 | 2.86 | 27 | 3.05 | 2.74 |
| 14. Demonstrations in college classes | 262 | 184 | 60 | 10 | 5 | 3 | 1.41 | 3 | 1.68 | 1.35 |
| 15. Elective science education research | 257 | 106 | 97 | 35 | 14 | 5 | 1.89 | 12 | 1.95 | 1.84 |
| 16. Encourage teaching experience | 260 | 155 | 43 | 28 | 21 | 13 | 1.82 | 8 | 2.40 | 1.68 |
| 17. Require teaching experience | 224 | 97 | 31 | 46 | 24 | 26 | 2.33 | 21 | 3.00 | 2.03 |
| 18. Inquiry approach | 254 | 127 | 76 | 37 | 10 | 4 | 1.77 | 7 | 1.93 | 1.70 |
| 19. Elective research in science | 253 | 115 | 81 | 40 | 12 | 5 | 1.86 | 11 | 1.99 | 1.79 |
| 20. Terminal program | 257 | 61 | 39 | 76 | 51 | 30 | 2.81 | 26 | 3.20 | 2.57 |
| 21. Enable pursuit of doctorate | 253 | 107 | 66 | 52 | 17 | 11 | 2.06 | 17 | 2.22 | 1.96 |
| 22. History &/or philosophy of science | 259 | 108 | 91 | 27 | 23 | 10 | 1.98 | 13 | 2.14 | 1.91 |
| 23. Without awarding master's degree | 258 | 18 | 17 | 42 | 48 | 133 | 4.01 | 29 | 4.22 | 3.83 |

TABLE 5.--Continued

| | Number of Responses | Agree Completely | Tend to Agree | Undecided | Tend to Disagree | Disagree Completely | Ranking Index for all Teachers | Rank According to Index of all Teachers | Ranking Index No Graduate Experience with Item | Ranking Index Graduate Experience with Item |
|---|---|---|---|---|---|---|---|---|---|---|
| 24. Specifically designed advanced science courses | 264 | 189 | 64 | 5 | 4 | 2 | 1.36 | 2 | 1.54 | 1.31 |
| 25. Graduate introductory science courses | 260 | 153 | 62 | 19 | 17 | 9 | 1.72 | 6 | 2.06 | 1.61 |
| 26. Mathematics requirement | 263 | 115 | 51 | 41 | 31 | 25 | 2.24 | 18 | 2.72 | 2.05 |
| 27. Calculus for physical science | 261 | 64 | 50 | 60 | 48 | 39 | 2.80 | 25 | 3.20 | 2.57 |
| 28. Ten hours in each area | 262 | 162 | 56 | 15 | 21 | 8 | 1.69 | 5 | 2.14 | 1.60 |
| 29. Institute type program | 262 | 101 | 84 | 52 | 16 | 9 | 2.04 | 14 | 2.23 | 1.94 |

TABLE 6.--Ranking Indices for Items 1 through 29 of Part Two According to Teaching Experience and Hours of Graduate Science

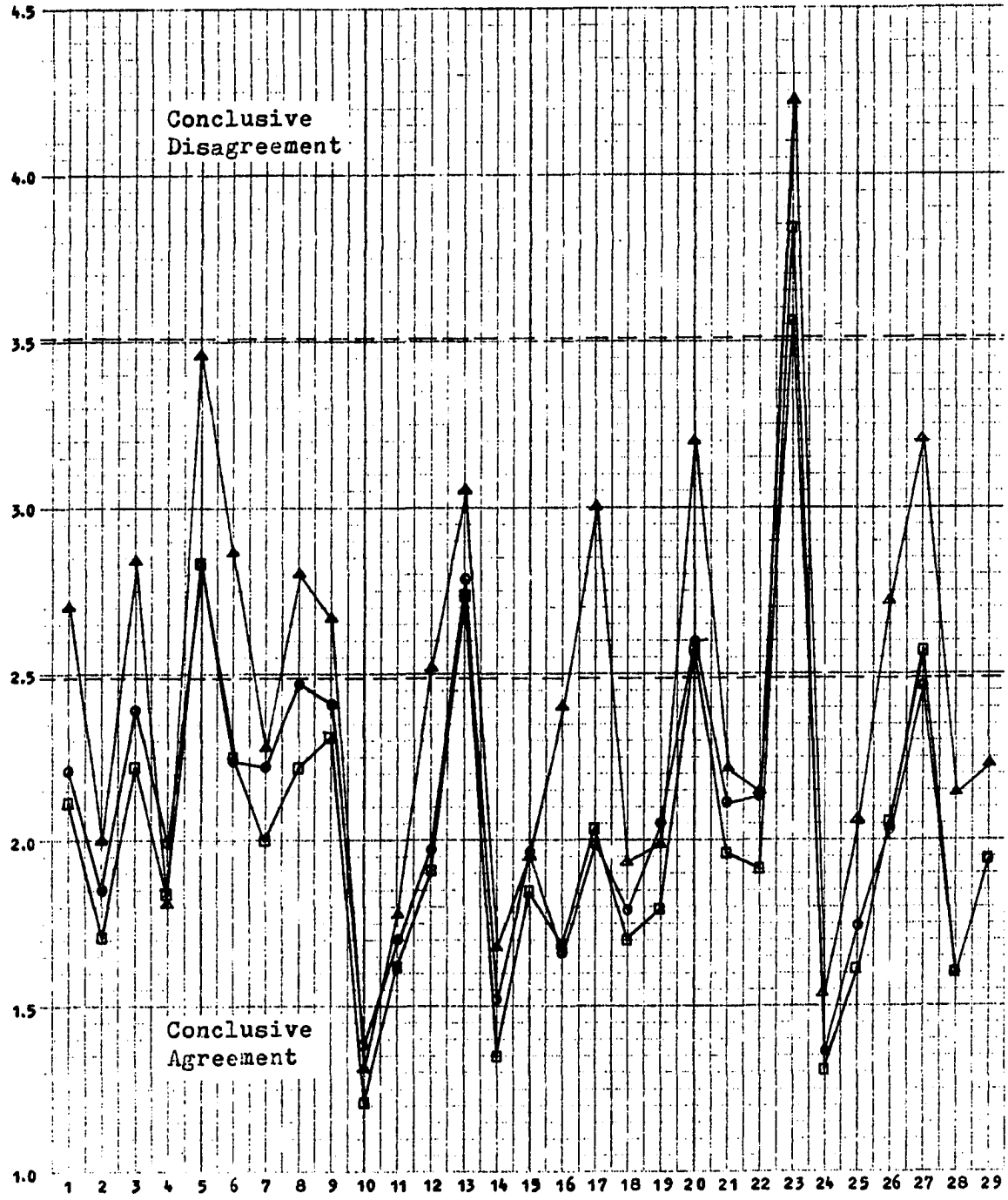
| | Ranking Index for Teachers with 1-6 Years Teaching Experience | Ranking Index for Teachers with 7 or More Years Teaching Experience | Ranking Index for Teachers with 0-20 Hours of Graduate Science | Ranking Index for Teachers with 21 or More Hours of Graduate Science | Ranking Index for Teachers with 21 or More Graduate Hours in a Single Science |
|---|---|---|---|---|---|
| 1. Cultural courses | 2.13 | 2.30 | 2.05 | 2.57 | 2.41 |
| 2. In-service credit | 1.69 | 1.85 | 1.80 | 1.89 | 1.79 |
| 3. Courses in administration | 2.21 | 2.48 | 2.29 | 2.55 | 2.58 |
| 4. Workshops combining science disciplines | 1.91 | 1.81 | 1.90 | 1.89 | 1.57 |
| 5. Thesis | 2.57 | 3.09 | 3.06 | 3.01 | 2.73 |
| 6. Formal science courses | 2.53 | 2.30 | 2.48 | 2.47 | 1.86 |
| 7. Consumers of science research | 2.07 | 2.05 | 2.02 | 2.19 | 1.96 |
| 8. Consumers of education research | 2.51 | 2.27 | 2.25 | 2.47 | 2.25 |
| 9. Graduate practice teaching | 2.72 | 2.44 | 2.54 | 2.43 | 2.43 |
| 10. Laboratory facilities | 1.26 | 1.23 | 1.27 | 1.20 | 1.18 |
| 11. Laboratory schools | 1.51 | 1.72 | 1.68 | 1.59 | 1.78 |
| 12. Flexible program | 2.09 | 2.05 | 1.86 | 2.03 | 2.54 |
| 13. Require science education research | 2.81 | 2.87 | 2.78 | 2.80 | 3.13 |
| 14. Demonstrations in college classes | 1.83 | 1.32 | 1.33 | 1.49 | 1.48 |

TABLE 6.--Continued

| | Ranking Index for Teachers with 1-6 Years Teaching Experience | Ranking Index for Teachers with 7 or More Years Teaching Experience | Ranking Index for Teachers with 0-20 Hours of Graduate Science | Ranking Index for Teachers with 21 or More Hours of Graduate Science | Ranking Index for Teachers with 21 or More Graduate Hours in a Single Science |
|---|---|---|---|---|---|
| 15. Elective science education research | 1.89 | 1.89 | 1.85 | 1.89 | 2.00 |
| 16. Encourage teaching experience | 2.02 | 1.78 | 1.88 | 1.67 | 1.87 |
| 17. Require teaching experience | 2.69 | 2.26 | 2.35 | 2.20 | 2.51 |
| 18. Inquiry approach | 1.49 | 1.84 | 1.80 | 1.75 | 1.73 |
| 19. Elective research in science | 1.94 | 1.84 | 1.95 | 1.77 | 1.74 |
| 20. Terminal program | 3.30 | 2.70 | 2.74 | 2.77 | 3.02 |
| 21. Enable pursuit of doctorate | 1.78 | 2.11 | 2.03 | 2.10 | 2.02 |
| 22. History &/or philosophy of science | 1.87 | 2.00 | 2.13 | 1.88 | 1.75 |
| 23. Without awarding master's degree | 3.72 | 4.02 | 3.98 | 4.06 | 4.04 |
| 24. Specially designed advanced science courses | 1.45 | 1.34 | 1.37 | 1.24 | 1.48 |
| 25. Graduate introductory science courses | 1.94 | 1.67 | 1.69 | 1.59 | 1.98 |

TABLE 6.--Continued

| | Ranking Index for Teachers with 1-6 Years Teaching Experience | Ranking Index for Teachers with 7 or More Years Teaching Experience | Ranking Index for Teachers with 0-20 Hours of Graduate Science | Ranking Index for Teachers with 21 or More Hours of Graduate Science | Ranking Index for Teachers with 21 or More Graduate Hours In a Single Science |
|---|---|---|---|---|---|
| 26. Mathematics requirement | 1.98 | 2.30 | 2.40 | 2.07 | 2.09 |
| 27. Calculus for physical science | 2.40 | 2.89 | 2.97 | 2.73 | 2.49 |
| 28. Ten hours in each area | 1.49 | 1.73 | 1.84 | 1.48 | 1.62 |
| 29. Institute type programs | 1.87 | 2.07 | 2.12 | 1.96 | 1.95 |

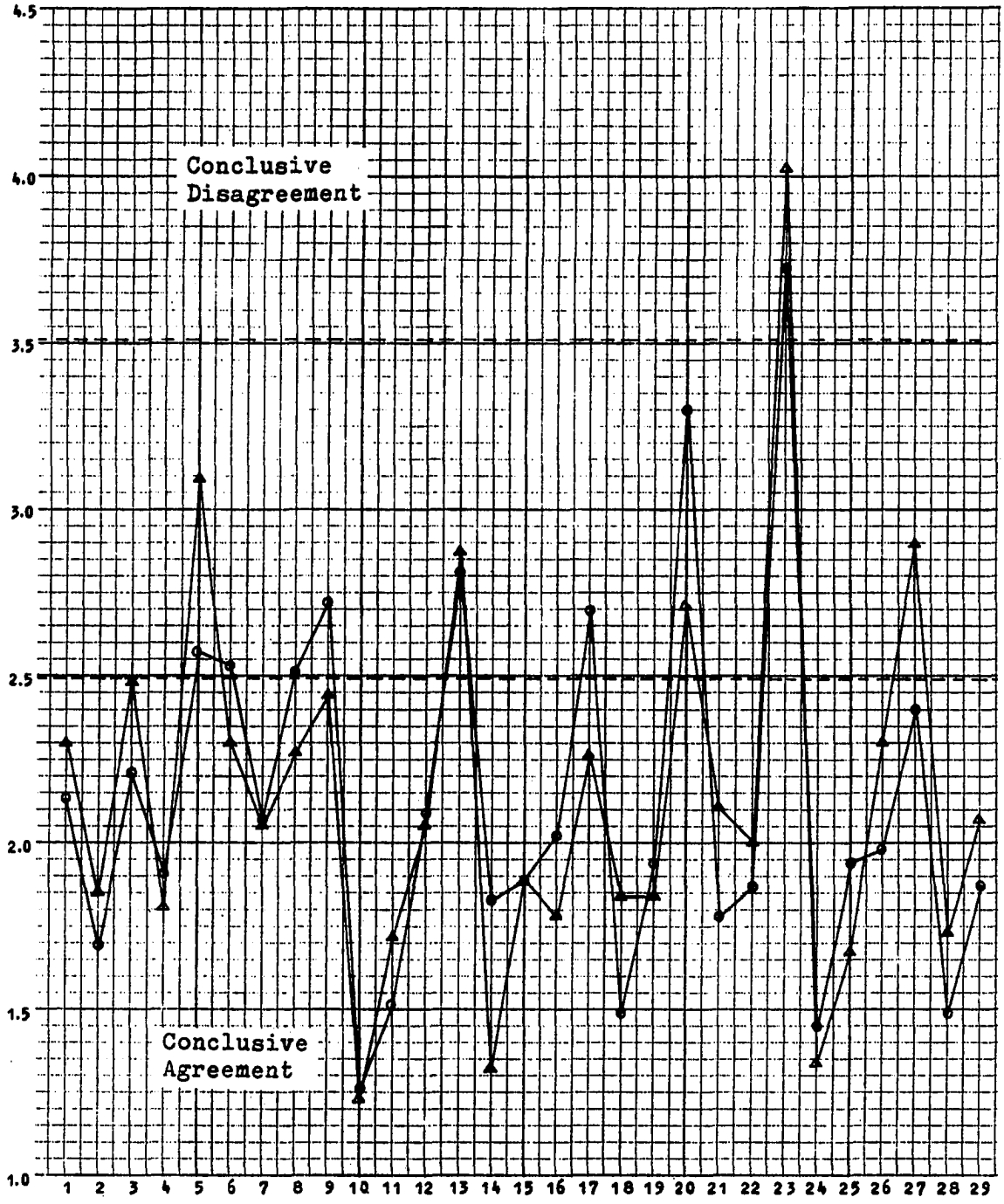



Graph 1.--Ranking indices for opinions of teachers on items 1 through 29 of Part Two.

o——— Value placed on the item in the teacher's experience.

□——— Recommendations by teachers indicating experience with the item.

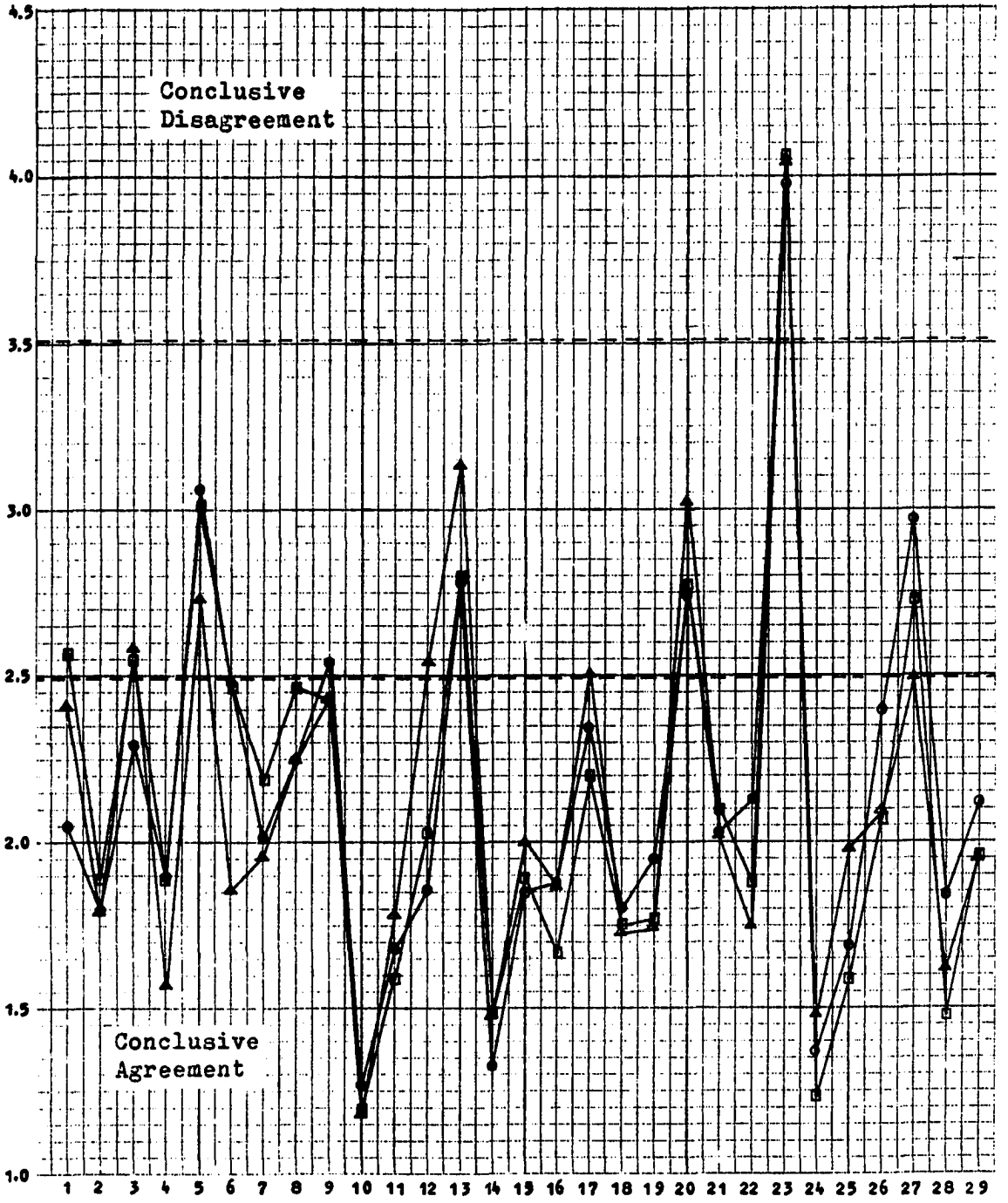
△——— Recommendations by teachers indicating lack of experience with the item.




Graph 2.--Ranking indices for opinions of teachers on items 1 through 29 of Part Two.

o——— Recommendations of teachers with 1-6 years teaching experience.

Δ——— Recommendations of teachers with 7 or more years teaching experience.




Graph 3.--Ranking indices for opinions of teachers on items 1 through 29 of Part Two.

o——— Recommendations of teachers with 0-20 hours of science.

□——— Recommendations of teachers with 21 or more hours of science in more than one area.

△——— Recommendations of teachers with 21 or more hours of science in a single area.

those for responses of teachers with zero to twenty semester hours of graduate science, those for responses of teachers with twenty-one or more total semester hours of graduate science, and those for responses of teachers with twenty-one or more semester hours of graduate science in a single science area.

To obtain the ranking index for an item, the frequency of responses to the item checked in column one was multiplied by one, the frequency of responses checked in column two was multiplied by two, and so on for each of the five columns. These products in each of the columns were added for an item and the sum was divided by the number of responses to the item to give the ranking index. The ranking index obtained in this manner for each item was used to rank the statements. The statement with the ranking index nearest 1.00 was given the rank order of one since this represented the highest value under "Experience" or most nearly complete agreement under "Recommendations." The statements were then ranked progressively down to the statement with a ranking index nearest five, which represented least value or most nearly complete disagreement.

For analytical purposes, giving an indication of intensity of response, a ranking index of 2.49 or less was selected as indicating conclusive value or agreement with the item, while a ranking index of 3.51 or greater was selected as indicating conclusive lack of value or disagreement with the item. These values were selected since any combination of two responses less favorable than one, agree completely, and three, undecided, gives a ranking index of 2.50 or greater; while a combination more favorable than five, disagree completely, and three,

undecided, gives a value of 3.50 or less.

Examination of data presented in Tables 4, 5, and 6 showed that a consensus was attained on most items. This was graphically illustrated by plotting the ranking indices for the established response categories. Graph 1 relates the ranking indices for responses to items one through twenty-nine on three different bases; the value the teachers placed on an item as a part of their graduate experience, agreement with the item as a recommendation for a fifth-year program by teachers who indicated experience with the item, and agreement with the item by the teachers who indicated no experience with the item in their graduate programs. Graph 2 relates the indices based on agreement with the items indicated by teachers with one to six years of teaching experience and agreement indicated by teachers with seven or more years of teaching experience. Graph 3 relates the same information but with plots based on responses by teachers with zero to twenty total semester hours of graduate science, those with more than twenty total semester hours of graduate science, and those with more than twenty semester hours of graduate science in a single science discipline.

In the following discussion the statements are listed in rank order based on ranking indices for all teachers presented in Table 5. Those indices were calculated from recommendations of all teachers responding to the statements dealing with the graduate education of high school science teachers. Responses to each statement are analyzed, proceeding from the statement with the lowest ranking index (highest rank) to that with the highest ranking index (lowest rank).

Statement 10.--Provide adequate laboratory facilities so that

teachers may have experience working with audio-visual, curriculum, and laboratory materials related to their particular science area.

This statement ranked first with a ranking index for all teachers of 1.23, which indicated conclusive agreement. Of the 264 responses to this item, 257 or 97.3 per cent agreed or tended to agree with the statement. Teachers having had graduate experience with the item tended to agree slightly more than those without the experience, showing a ranking index of 1.21. Data in Table 6 show that teachers with 21 or more total hours of graduate science and those with 21 or more hours of graduate science in one area tended to agree with the statement more than did those with less than 21 hours of graduate science, showing indices of 1.20 and 1.18 compared to 1.27. Those teachers with more teaching experience tended to agree slightly more than did those with less than 7 years experience. Data in Table 4 show that teachers indicating graduate experience with the item tended to agree with the statement as a recommendation for a graduate program to a greater degree than the value they placed on the item in their own experience, showing ranking indices of 1.21 and 1.38.

Statement 24.--Provide advanced courses in science areas designed especially for secondary teachers.

This statement ranked second with a ranking index for all teachers of 1.36, which indicated conclusive agreement. Agree completely or tend to agree was checked by 253 or 95.8 per cent of the 264 teachers responding to this item. Teachers indicating graduate experience with the item tended to agree more than did those without the experience, showing a ranking index of 1.31. These same teachers indicated a little less

value of the item in their graduate experience, with an index of 1.36; however, this ranking index indicated the greatest value given a statement by these teachers and the statement ranked first in value in their graduate experience. Teachers with 7 or more years teaching experience tended to agree with the statement more than did teachers with less experience, showing indices in Table 6 of 1.34 and 1.45. The teachers with 21 or more total hours of graduate science tended to agree more than did those with fewer hours or those with 21 or more graduate hours in a single area, showing a ranking index of 1.24.

Statement 14.--Use instructional methods in college classes which emphasize demonstrations, class participation, and use of audio-visual aids.

A ranking index of 1.41 was calculated for recommendations of all teachers. This indicated conclusive agreement with the statement and gave it a rank order of three. Of the 262 teachers responding to this item, 244 or 93.1 per cent checked tend to agree or agree completely. Teachers indicating graduate experience with the item tended to agree with it more than did those teachers not indicating the experience, showing an index of 1.35. The value placed on the item in the teacher's experience shown in Table 4, was given a calculated ranking index of 1.52. The rank order based on the indices was three in each case, however. Teachers with more than 6 years teaching experience and those with fewer than 21 hours of graduate science exhibited a greater tendency to agree with the statement than did those with less experience or more hours of graduate science, showing indices of 1.32 and 1.33 in Table 6.

Statement 11.--Provide the use of laboratory schools (public

or college connected) for demonstration, research, and experimentation.

This statement ranked fourth with a ranking index of 1.68 for all teachers responding. This value was taken to indicate conclusive agreement with the statement. Agree completely or tend to agree was checked by 220 or 84.6 per cent of the 260 teachers responding. Teachers having had graduate experience with the item tended to agree with it more than did those without the experience; and once more they placed less value on the item as a result of their experience than they expressed as a recommendation for it in a graduate program. Data in Table 4 show also that 38.72 per cent of the teachers indicated no experience with the item in their graduate work. Data in Table 6 show that teachers with less than 7 years experience (index 1.51) and those with 21 or more total hours of graduate science (index 1.59) tended to agree with the statement more than did those teachers with more experience, fewer hours of graduate science, or more than 21 hours of graduate science in one area.

Statement 28.--Require the completion (undergraduate or post-graduate) or a minimum of 10 semester hours in each of the following (regardless of the major science area): biology, chemistry, and physics.

The ranking index of 1.69 for all teachers responding was taken to indicate conclusive agreement with the statement. The item was ranked fifth with 218 or 83.2 per cent of the 262 respondents checking agree completely or tend to agree. Teachers indicating graduate experience with the item tended to agree with the statement more than did those not indicating the experience, showing indices of 1.60 and 2.14. The ranking index based on the value of the item in the teachers graduate experience, shown in Table 4, was calculated to be 1.60 also and ranked

fourth in value. Teachers with less than 7 years teaching experience and those with more than 20 total hours of graduate science tended to agree with the statement more, with indices of 1.49 and 1.48 shown in Table 6. Teachers with less than 21 hours of graduate science tended less to agree with the statement than did those with more graduate science.

Statement 25.--Provide introductory courses in science which are related to his major area and which offer graduate credit, without prerequisites, and are prepared especially for secondary teachers.

This statement ranked sixth with a ranking index of 1.72 for all teachers responding. That was interpreted as indicating conclusive agreement. Teachers indicating graduate experience with the statement tended to agree more with it than did those indicating no graduate experience with the statement, showing ranking indices of 1.61 and 2.06. Teachers having had experience with the statement tended to agree with it to a greater degree than they valued it in their graduate work, with indices of 1.61 and 1.74. Data in Table 6 show that those teachers with less than 7 years experience and those with 21 or more hours of graduate science in a single area tended less to agree with the statement as indicated by ranking indices of 1.94 and 1.98. Individuals with 21 or more total semester hours of graduate science agreed with the item to the greatest extent, with a ranking index of 1.59. Of the teachers responding, 215 or 82.7 per cent of the 260 checked agree completely or tend to agree.

Statement 18.--Include at least one science course taught by the inquiry or discovery approach.

This statement ranked seventh. Of the 254 teachers responding to the statement, 203 or 79.9 per cent agreed or tended to agree, giving a

ranking index of 1.77. This indicated conclusive agreement with the statement. Again teachers having graduate experience with the item showed a greater tendency to agree with it than did those teachers without the experience. The indices were 1.70 and 1.93. Data in Table 4 show that again the teachers having had experience with the item valued it a little less (index 1.79) than they agreed with it as a recommendation (index 1.70). Of the 257 teachers responding to the statement, 32.68 per cent indicated no experience with it in their graduate work. High or moderate value was assigned the item by 80.9 per cent of the teachers who indicated experience with it. Data in Table 6 show that teachers with less than 7 years teaching experience tended to agree with the statement to a greater extent than did any other category, with a ranking index of 1.49. Teachers with more graduate science tended to agree with the item slightly more than did those with 20 or less hours of graduate science.

Statement 2.--Provide in-service courses for individual or group study of local science education problems for which credit is received.

The ranking index for all teachers responding to this statement was calculated to be 1.82 which gave it a rank order of eight and indicated conclusive agreement with the statement. Agree or tend to agree was checked by 214 or 81.7 per cent of the 262 teachers responding. Teachers indicating experience with the item tended to agree (index 1.71) to a greater extent than did those without the experience (index 2.00). They also tended to agree with the item to a greater degree than they found it of value (index 1.85) in their experience with it. In Table 4, of the 267 teachers responding to this statement, 37.45 indicated no

experience with it. Teachers with less teaching experience (index 1.69) tended to agree with the statement more than did the teachers with 7 or more years experience--index 1.85. Teachers with more than 20 hours of graduate science in a single area and those with fewer than 21 hours tended to agree with the statement more than those with 21 or more total hours of graduate science.

Statement 16.--Students should be encouraged to have at least one year full-time teaching experience before entering the fifth-year program.

The ranking index for this statement was 1.82 also, giving it a tie rank of eight with statement 2. Teachers who had graduate experience with the statement tended to agree with it more than did those without the experience, showing indices of 1.68 and 2.40. Of those teachers who indicated experience with the item, 81.1 per cent checked moderate or high value for it. A ranking index of 1.66 was calculated from the value expressed by those teachers. As shown in Table 4, the statement ranked fifth in value in the teachers' experience. Data in Table 6 show that teachers with 21 or more total hours of graduate science tended to agree with the statement more than did those with less science and those with 21 or more hours of graduate science in a single area, showing indices of 1.67, 1.88 and 1.87. Those teachers with more teaching experience tended to agree more than did those with less than 7 years teaching experience, showing indices of 1.78 and 2.02. Of the 260 teachers responding to this statement, 198 or 76.2 per cent agreed or tended to agree with it. The overall index of 1.82 indicated conclusive agreement with the statement.

Statement 4.--Provide workshops that combine the scientific disciplines for a better understanding of their interdependence.

As shown in Table 5, a rank of ten was given this statement. Of the 259 teachers responding, 206 or 79.5 per cent agreed or tended to agree with the statement. An overall ranking index of 1.83 was calculated which indicated conclusive agreement with the statement. Teachers indicating no graduate experience with the item tended to agree with it slightly more than did those teachers who had experience, showing indices of 1.81 and 1.84. Data in Table 4 show a value ranking index of 1.99 calculated from value checked by teachers who had experience with the item. As shown in Table 6 those teachers with 21 or more hours of graduate science in a single area tended to agree with the statement more than did those with less science, having an index of 1.57. Teachers with more than 6 years teaching experience tended to agree with the statement more than those with less experience, showing indices of 1.81 and 1.91.

Statement 19.--Encourage research in a science area for credit on an elective basis.

This statment was ranked eleventh with a ranking index of 1.86 which was taken to indicate conclusive agreement. Agree completely or tend to agree was checked by 196 or 77.5 per cent of the 253 teachers who responded. Teachers who indicated experience with the item in their graduate program tended to agree with it more than those without the experience, showing indices of 1.79 and 1.99. Data in Table 4 show that the value placed on the item in their graduate experience was less, showing a ranking index of 2.05. Data in Table 6 show that teachers with more than 6 years teaching experience demonstrated a greater tendency to

agree with the item than teachers with less experience, exhibiting ranking indices of 1.84 and 1.94. Those teachers with more than 20 hours of graduate science in a single area and those with a total of more than 20 hours of graduate science displayed a greater tendency to agree with the statement than did those with zero to twenty hours, showing indices of 1.74, 1.77 and 1.95.

Statement 15.--Provide for research in science education to be taken for credit on an elective basis.

The ranking index of 1.89 for all teachers responding to this item indicated conclusive agreement and gave it the rank of twelve, as shown by data in Table 5. Of the 257 teachers responding to the item, 203 or 79.0 per cent checked agree or tend to agree. Teachers having graduate experience with the statement tended to agree slightly more than did those without the experience, with indices of 1.84 and 1.95. They also tended to agree with the item as a recommendation more than the value they placed on the item in their experience. The value ranking index from Table 4 for teachers indicating experience with the item was 1.96. There was no difference in the ranking indices of the two teaching-experience categories in Table 6. Teachers with more than 20 hours of graduate science in a single area showed a little less tendency to agree with the item than did those with 21 or more total hours of graduate science and those with 20 or less hours of science. The ranking indices were 2.00, 1.89, and 1.85.

Statement 22.--Include a course in the history and/or philosophy of science.

This statement ranked thirteenth. Of the 259 teachers responding

to the statement, 199 or 76.8 per cent indicated they agreed or tended to agree with it (Table 5). This gave a ranking index of 1.98 for all teachers responding, indicating conclusive agreement with the statement. Teachers who had experience with the item tended to agree with it more (ranking index 1.91) than did those without the experience (ranking index 2.14). They also tended to agree with the item as a recommendation for a graduate program more than they valued it in their experience. The data in Table 4 show a ranking index of 2.13 for value placed on the item in the teachers' experience. The data in Table 6 show that teachers with more than 20 hours of graduate science in a single area tended to agree with the statement more than did those with less science, showing an index of 1.75. Teachers with fewer than 7 years experience tended to agree more than did those with more experience; indices 1.87 and 2.00.

Statement 29.--Include programs designed outside the regular class structure patterned after NSF Institute type programs but not necessarily nationally sponsored with participant stipends.

A ranking index of 2.04, found in Table 5, for this statement gives it a rank order of fourteen and was interpreted to indicate conclusive agreement. Those data show also that teachers who had experience with the item in their graduate work tended to agree with it more than did those who had not had the experience--ranking indices 1.94 and 2.23. Data in Table 4 show that the ranking index based on the value the teachers assigned to the item in their experience was also 1.94. Of the teachers indicating experience with the item, 72.6 per cent assigned it moderate or high value. The data in Table 6 show that teachers with less experience tended to agree with the statement more than did the

teachers with 7 or more years experience--indices 1.87 and 2.07. Teachers with 21 or more hours of graduate science in a single area and those with 21 or more total hours of graduate science tended to agree more than those with less than 21 hours--indices 1.95, 1.96, and 2.12. Of the 262 teachers responding to the item, 185 or 70.6 per cent agreed or tended to agree.

Statement 12.--A flexible program with few specific course requirements in either science or education so that a teacher may elect those courses which best meet his needs.

This statement was ranked fifteenth based on the ranking index calculated from the responses of all teachers in the study. The ranking index of 2.05 shown in Table 5 was taken to indicate conclusive agreement with the statement as a recommendation for a graduate program. Those data show that 191 or 72.6 per cent of the 263 teachers responding to the statement agreed or tended to agree with it. Teachers who indicated they had experienced a flexible program agreed with it considerably more than did those teachers without the experience, showing indices of 1.91 and 2.52. The value the teachers placed on the item in their graduate experience shows a ranking index of 1.97 in Table 4. Data in Table 6 show little difference in the indices of teachers with 6 or fewer years teaching experience and those with more experience. Teachers with more graduate science agreed less with the statement. Those teachers with 21 or more hours of graduate science in a single area showed a ranking index of 2.54, which would indicate inconclusive agreement for that group; those with twenty-one or more total hours of science showed an index of 2.03; and those with twenty hours or less showed an index of 1.86.

Statement 7.--Emphasize scientific research from the point of view

of preparing teachers to become intelligent consumers of such research.

This statement showed a ranking index of 2.05 also, which was taken to indicate conclusive agreement and gave it a tie rank order with statement twelve of fifteen. One hundred eighty-nine (73.3 per cent) of the 258 teachers responding to the statement agreed or tended to agree with it. A ranking index of 2.00 was determined for teachers who had experience with the item in their graduate program and an index of 2.28 was determined for those indicating no graduate experience with the item. Data in Table 4 show a ranking index of 2.22 for value placed on the item in the teachers' experience. Data in Table 6 show little difference in tendency to agree with the statement by teachers with 6 or less years experience and those with 7 or more years experience. Teachers with 21 or more hours of graduate science in one area tended to agree with the statement more, as shown by the ranking index of 1.96. Teachers with less than 21 hours of graduate science showed a greater tendency to agree with the statement than did those with 21 or more total hours, showing indices of 2.02 and 2.19.

Statement 21.--So design the program that its completion will enable a person to pursue the doctorate in science education.

This statement ranked seventeenth with a ranking index of 2.06, which indicated conclusive agreement. Based on responses of 253 teachers, 173 (68.4 per cent) agreed or tended to agree with the statement. The data in Table 5 show that the teachers indicating experience with the item tended to agree with it more than teachers who had not had the graduate experience--ranking indices 1.96 and 2.22. Those teachers having had experience with the statement tended to agree with it more

strongly as a recommendation for a graduate program than they valued the item in their experience. Data in Table 4 show a ranking index of 2.11 for the value placed on the item. Data in Table 6 show that teachers with less than 7 years teaching experience tended to agree with the statement more (index 1.78) than did those with more experience (index 2.11). Teachers with 20 hours or less of graduate science (index 2.03) and those with 21 or more hours in a single area (index 2.02) tended to agree with the statement slightly more than did those with 21 or more total hours of graduate science (index 2.10).

Statement 26.--The completion of the fifth year should have as a prerequisite the completion of mathematics through algebra, trigonometry, and analytical geometry either as an undergraduate or postgraduate.

Data in Table 5 show a ranking index of 2.24 for all teachers responding to the statement. This was taken as conclusive agreement. Of the 263 teachers responding, 166 (63.1 per cent) agreed or tended to agree with the statement. The rank order was eighteen. The teachers who had experience with the item showed a ranking index of 2.05. They tended to agree with the statement to a greater extent than did the teachers without the experience. A ranking index of 2.72, which would be considered inconclusive agreement was shown by this group. According to the ranking index of 2.03 shown in Table 4, the teachers who had experience with the item placed a slightly higher value on it in their experience than they expressed as a recommendation for a graduate program. Also, the data show a rank order of fifteen for the item based on the value expressed by those teachers. Data in Table 6 show that teachers with 6 or fewer years teaching experience, with an index of 1.98, showed a

greater tendency to agree with the statement than teachers with more experience, who showed an index of 2.30. Teachers with 21 or more hours of graduate science in a single area (ranking index 2.09) and those with 21 or more total hours of graduate science (ranking index 2.07) tended to agree with the statement more than those teachers with 20 or fewer hours of graduate science (ranking index 2.40).

Statement 1.--Provide teachers of high school science with an opportunity to improve their cultural backgrounds by taking some work in cultural fields outside the science and professional education fields.

This statement ranked nineteenth based on the ranking index of 2.27 for all teachers responding to the statement. Of the 263 teachers responding, 180 (68.4 per cent) checked agree completely or tend to agree. Again the teachers indicating graduate experience with the item showed a greater agreement with it than did those teachers indicating no graduate experience with the item, showing indices of 2.11 and 2.70. The index 2.70 was interpreted as inconclusive agreement on the part of those teachers. Data in Table 4 show a ranking index of 2.21 and a rank order of nineteen for the value placed on the item in the experience of those teachers. Of the teachers who indicated experience with the item, 72.3 per cent checked high or moderate value relative to their experience. Data from Table 6 show teachers with less than 7 years teaching experience tended to agree with the statement more than those with more experience. Also, those teachers with 20 or less hours of graduate science (index 2.05) tended to agree with the statement more than the teachers with 21 or more hours of graduate science in a single area (index 2.41) and those

with 21 or more total hours of graduate science (index 2.57).

Statement 8.--Emphasize educational research from the point of view of preparing teachers to become intelligent consumers of such research.

Data in Table 5 show this statement to have a ranking index of 2.31 for all teachers responding which was considered to indicate conclusive agreement with the statement. Of the 256 teachers responding to the statement, 168 (65.6 per cent) agreed or tended to agree with it as a recommendation for the graduate education of high school science teachers. This statement ranked twentieth. Teachers who had graduate experience with the item were in conclusive agreement with it (index 2.22) while those indicating no experience with the item showed a ranking index of 2.80 and inconclusive agreement with the statement. Data in Table 4 show that 16.60 per cent of the teachers indicated no graduate experience with the item. Those data show also a ranking index of 2.47 based on the value of the item in the teachers' graduate program. In Table 6, the data show the teachers with 7 or more years experience tended to agree with the statement more than did teachers with less experience--indices 2.27 and 2.51. Also, teachers with 20 hours or less of graduate science and teachers with 21 or more hours of graduate science in one area tended to agree more (index 2.25) than did the teachers with 21 or more total hours of graduate science (index 2.47).

Statement 17.--Students should be required to have at least one year of full-time teaching experience before entering the fifth-year program.

This statement was ranked twenty-first based on the ranking index

of 2.33 for all teachers responding. Data in Table 5 show that of the 224 teachers responding to this item, 128 (57.1 per cent) agreed or tended to agree and 46 (20.5 per cent) were undecided. The overall index of 2.33 was taken to indicate conclusive agreement with the statement. Teachers who indicated experience with the item showed much greater tendency to agree with the item (ranking index 2.03) than did those teachers without experience with the item (ranking index 3.00). Data in Table 4 show that 31.72 per cent of the teachers responding indicated no experience with the item. That data show also that those teachers who had experience with the item attached a conclusive value to the item as indicated by the ranking index, 1.99. They ranked the item thirteenth in value. In Table 6, the data show that teachers with 7 or more years experience tended to agree with the statement more than did teachers with less teaching experience, showing indices of 2.26 and 2.69. Teachers with a total of more than 20 hours of graduate science tended to agree with the statement more (index 2.20) than those with less than 21 hours of graduate science (index 2.35) and those with 21 or more hours of graduate science in a single area (index 2.51). Thirty-five (15.6 per cent) of the respondents indicated the need for more than one year of teaching experience before entering the fifth-year program. The range of suggestions was from 2 years to 4 years teaching experience with a mean of 2.57 years.

Statement 6.--Provide formal science courses which place emphasis on theoretical knowledge and technical skills without reference to classroom teaching.

Of the 262 teachers responding to this statement, 170 or 64.9 per

cent agreed or tended to agree with it. The data in Table 5 show that the overall ranking index was 2.34, which gave the item the rank order of twenty-two. The teachers who had experience with the item tended to agree with it more than did those who had not had the experience--indices 2.25 and 2.87. The data in Table 4 show the ranking index 2.24 for value placed on the item by those who had experience with it. From Table 6, the data show that teachers with 21 or more hours of graduate science in a single area tended to agree with the item more (index 1.86) than did teachers with 21 or more total hours of graduate science (index 2.47) or teachers with less graduate science (index 2.48). Teachers with 7 or more years experience (index 2.30) tended to agree with the statement more than teachers with less experience--index 2.53.

Statement 3.--Provide a general course in school administration for a better understanding of the job of the school superintendent and principal.

This statement ranked twenty-third. Of the 261 teachers responding to the statement, 158 or 60.5 per cent agreed or tended to agree with it. The ranking index of 2.42 for all teachers responding placed this statement in the conclusive agreement category. Those teachers who had experience with the item tended to agree more, with an index of 2.22. The data in Table 4 show that 68.56 per cent of the teachers indicated experience with the item and gave it a ranking index of 2.39 based on the value of the item in their experience. Data in Table 6 show that teachers with 6 or fewer years teaching experience (index 2.21) and those with 20 or less hours of graduate science (index 2.29) tended to agree with the statement more than did other categories.

Statement 9.--Provide opportunities for the teacher to apply and extend his professional competence through directed practice teaching at the graduate level.

The data in Table 5 show that 143 or 54.0 per cent of the 265 teachers responding to the item agreed or tended to agree with it and almost 23 per cent were undecided. The overall ranking index was 2.48 which was taken to indicate conclusive agreement though it was near the limit of 2.49. Those teachers indicating graduate experience with the item tended to agree with it more, showing an index of 2.31. Data in Table 4 show that 50.75 per cent of the teachers indicated experience with the item and gave it a ranking index of 2.41 based on the value they placed on the item. Three of the categories shown in Table 6 were in conclusive agreement with the statement. Teachers indicating less than 7 years teaching experience and those with less than 21 hours of graduate science demonstrated less tendency to agree with the statement--ranking indices 2.72 and 2.54. This statement ranked twenty-fourth.

Statement 27.--The completion of the fifth year should have as a prerequisite the completion of mathematics through two semesters of calculus either as undergraduate or postgraduate work for the physical science major.

Rank: 25. The ranking index of 2.80 was taken to indicate inconclusive agreement. The data in Table 5 show that of the 261 teachers responding to the statement, 43.7 per cent agreed or tended to agree, 23.0 per cent were undecided, and 33.3 per cent disagreed or tended to disagree with it. Teachers who had experience with the item showed a greater tendency to agree with it, with a ranking index of 2.57. As

shown in Table 4, 62.26 per cent of the teachers indicated experience with the item and gave it the ranking index 2.46 based on the value of the item in their programs. Of the teachers indicating experience with the item, 55.8 per cent checked high or moderate value for it. Data in Table 6 show that teachers with less teaching experience and those with more graduate work in a single science area tended to agree more with the statement--ranking indices 2.40 and 2.49. The relatively large ranking index (2.80) for this item might be explained by the fact that a majority of the respondents were biology teachers who may feel less need for mathematics through calculus than do teachers in the physical sciences.

Statement 20.--The fifth year should be a terminal program independent of providing prerequisites for doctoral study.

This statement ranked twenty-sixth. The ranking index of 2.81 was taken to indicate inconclusive agreement. The data show that of the 257 teachers responding to the item, 38.9 per cent agreed or tended to agree and 31.5 per cent disagreed or tended to disagree. Teachers having had experience with the item tended to agree more, showing an index of 2.57. The index 2.60 (Table 4) was calculated for the value placed on the item in the experience of those teachers. Data in Table 6 show that teachers with less than 7 years teaching experience and those with more than 20 hours of graduate science in a single area tended more to disagree with the statement, showing indices of 3.30 and 3.02.

Statement 13.--Require that the graduate student conduct a research project in science education.

Of the 261 teachers responding to this statement, 112 or 42.9

per cent agreed or tended to agree and 36.8 per cent disagreed or tended to disagree. The statement was given the rank order twenty-seven. The ranking index of 2.86 for all the teachers was interpreted as inconclusive agreement. Teachers who indicated experience with the item tended to agree with it more, showing an index of 2.74. The data in Table 4, show that the ranking index based on the value of the item in the teachers' program was 2.78 and the rank order of the item based on this index was twenty-seven, the same rank as was given by all the teachers. Data in Table 6 show teachers with 21 or more hours of graduate science in one area (index 3.13) showed less tendency to agree with the item than did other categories. Teachers with 6 or less years experience showed a slightly greater tendency to agree with the statement than did teachers with more experience.

Statement 5.--Require the completion of a thesis for the master's degree.

This statement ranked twenty-eighth. Table 5 shows the ranking index to be 3.00 which is inconclusive. While 43.3 per cent of the 261 teachers who responded to the statement disagreed or tended to disagree and 38.3 per cent agreed or tended to agree, only 38 disagreed completely and 51 agreed completely. Again, those teachers who indicated experience with the item showed a greater tendency to agree with it. Data in Table 4 show that the teachers who had experience with the item gave it the same rank order relative to the value of the item as was given by all the teachers as a recommendation for a graduate program. The ranking index 2.83 was calculated based on the value indicated for the item. Approximately 50 per cent of the teachers who indicated experience with

the item checked high or moderate value. Data in Table 6 show that teachers with 1 to 6 years teaching experience and those with 21 or more hours of graduate science in one area showed inconclusive agreement with the statement (indices 2.57 and 2.73) while the other categories showed very slight tendencies to disagree.

Statement 23.--The fifth year should be considered a fifth year of teacher education without awarding a master's degree.

This statement ranked twenty-ninth. Of the 258 teachers responding to the statement, 181 or 70.2 per cent disagreed or tended to disagree. The ranking index of 4.01 for all teachers responding was taken to indicate conclusive disagreement with the statement as a recommendation for the graduate education of the high school science teacher. Teachers who indicated no experience with the item disagreed with it more strongly than did those who indicated experience. The ranking index of 3.56, shown in Table 4, based on the value expressed for the item was taken to indicate conclusive lack of value, with 3.51 or greater set as conclusive lack of value. The data in Table 6 show all categories indicated conclusive disagreement with the statement, though teachers with 7 or more years experience and those with more than 20 hours of graduate science expressed somewhat stronger disagreement.

Analysis of the data in Tables 4, 5, and 6 showed that all categories of teachers responding indicated conclusive agreement with 16 of the statements and all categories indicated conclusive disagreement with only one statement. Based on the overall ranking indices for all teachers responding, conclusive agreement was indicated for 24 of the 29 items and conclusive disagreement for only one.

## Analysis of Opinions of Administrators and Science Teachers Concerning Statements 1-29 of Part Two

The responses of administrators concerning their experience with items one through twenty-nine of Part Two of the questionnaire are presented in Table 7. Those responses were made relative to the value the administrator placed on the item in his graduate experience. The total response to each item, the number responding in each category, the percentage reporting no graduate experience with the item, the ranking index of each item, and the rank according to the ranking index are shown. Responses of the administrators to the same items concerning their recommendations relative to the graduate education of the high school science teacher are presented in Table 8. Those responses were analyzed relative to the graduate experience of the administrator with the item. The total response to each item, the number of responses in each category, the ranking index for all administrators responding, the rank of each statement based on the ranking index for all administrators responding, the ranking index for administrators indicating no experience with the item, and the ranking index for administrators indicating experience with the item are presented in Table 8.

Data shown in Tables 7 and 8 were graphically illustrated by plotting ranking indices for the response categories. Graph 4 relates the ranking indices for responses of school administrators to items one through twenty-nine on three different bases: the value the administrators placed on the item as a part of their graduate experience, agreement with the item as a recommendation for a fifth-year program by administrators who indicated experience with the item, and agreement with the item by administrators who indicated no experience with the item in their graduate program.

TABLE 7.--Responses of Administrators to Part Two Concerning Their Experience with Items 1 through 29 with Ranking Indices to Show the Rank of the Item

| | Number of Responses | High Value | Moderate Value | Undecided | Little Value | Of No Value | No Experience with Item | Percentage Reporting No Experience with Item | Ranking Index Graduate Experience with Item | Rank According to Index |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Cultural courses | 79 | 27 | 30 | 0 | 2 | 0 | 20 | 25.32 | 1.61 | 5 |
| 2. In-service credit | 78 | 21 | 19 | 4 | 4 | 0 | 30 | 38.46 | 1.81 | 8 |
| 3. Courses in administration | 77 | 30 | 24 | 7 | 5 | 2 | 9 | 11.69 | 1.90 | 9 |
| 4. Workshops combining science disciplines | 79 | 13 | 26 | 9 | 3 | 2 | 26 | 32.91 | 2.15 | 16 |
| 5. Thesis | 78 | 11 | 19 | 6 | 22 | 5 | 15 | 19.23 | 2.86 | 27 |
| 6. Formal science courses | 78 | 7 | 17 | 9 | 19 | 7 | 19 | 24.36 | 3.03 | 28 |
| 7. Consumers of science research | 77 | 16 | 25 | 6 | 8 | 3 | 19 | 24.68 | 2.26 | 19 |
| 8. Consumers of education research | 77 | 22 | 26 | 5 | 11 | 1 | 12 | 15.58 | 2.12 | 14 |
| 9. Graduate practice teaching | 79 | 13 | 23 | 10 | 7 | 4 | 22 | 27.85 | 2.40 | 21 |
| 10. Laboratory facilities | 79 | 51 | 7 | 2 | 2 | 0 | 17 | 21.52 | 1.27 | 1 |
| 11. Laboratory schools | 79 | 30 | 16 | 4 | 4 | 0 | 25 | 31.64 | 1.67 | 6 |
| 12. Flexible program | 79 | 14 | 22 | 4 | 11 | 6 | 22 | 27.85 | 2.53 | 24 |
| 13. Require science education research | 79 | 7 | 16 | 12 | 12 | 4 | 28 | 35.44 | 2.80 | 25 |

TABLE 7.--Continued

| | Number of Responses | High Value | Moderate Value | Undecided | Little Value | Of No Value | No Experience with Item | Percentage Reporting No Experience with Item | Ranking Index Graduate Experience with Item | Rank According to Index |
|---|---|---|---|---|---|---|---|---|---|---|
| 14. Demonstrations in college classes | 79 | 42 | 19 | 2 | 1 | 1 | 14 | 17.72 | 1.46 | 2 |
| 15. Elective science education research | 79 | 10 | 21 | 11 | 1 | 1 | 35 | 44.30 | 2.14 | 15 |
| 16. Encourage teaching experience | 79 | 42 | 13 | 4 | 3 | 2 | 15 | 18.99 | 1.59 | 4 |
| 17. Require teaching experience | 65 | 23 | 8 | 7 | 1 | 1 | 25 | 38.46 | 1.72 | 7 |
| 18. Inquiry approach | 79 | 16 | 18 | 10 | 0 | 1 | 34 | 43.04 | 1.93 | 11 |
| 19. Elective research in science | 77 | 10 | 23 | 11 | 3 | 1 | 29 | 37.66 | 2.21 | 17 |
| 20. Terminal program | 78 | 13 | 24 | 17 | 4 | 1 | 19 | 24.36 | 2.25 | 18 |
| 21. Enable pursuit of doctorate | 79 | 10 | 20 | 12 | 4 | 3 | 30 | 37.97 | 2.39 | 20 |
| 22. History &/or philosophy of science | 78 | 19 | 19 | 5 | 4 | 2 | 29 | 37.18 | 2.00 | 12 |
| 23. Without awarding a master's degree | 78 | 4 | 8 | 11 | 6 | 13 | 36 | 46.15 | 3.38 | 29 |
| 24. Specially designed advanced science courses | 77 | 28 | 22 | 5 | 0 | 0 | 22 | 28.57 | 1.58 | 3 |

TABLE 7.--Continued

| | Number of Responses | High Value | Moderate Value | Undecided | Little Value | Of No Value | No Experience with Item | Percentage Reporting No Experience with Item | Ranking Index Graduate Experience with Item | Rank According to Index |
|---|---|---|---|---|---|---|---|---|---|---|
| 25. Graduate introductory science courses | 77 | 17 | 22 | 8 | 2 | 0 | 28 | 36.36 | 1.90 | 9 |
| 26. Mathematics requirement | 77 | 13 | 13 | 9 | 4 | 5 | 33 | 42.86 | 2.43 | 23 |
| 27. Calculus for physical science | 77 | 8 | 12 | 11 | 9 | 6 | 31 | 40.26 | 2.85 | 26 |
| 28. Ten hours in each area | 78 | 19 | 21 | 9 | 4 | 1 | 24 | 30.76 | 2.02 | 13 |
| 29. Institute type programs | 78 | 5 | 20 | 16 | 2 | 1 | 34 | 43.58 | 2.41 | 22 |

TABLE 8.--Responses of Administrators to Part Two Concerning Their Recommendations Relative to Items 1 through 29 with Ranking Indices

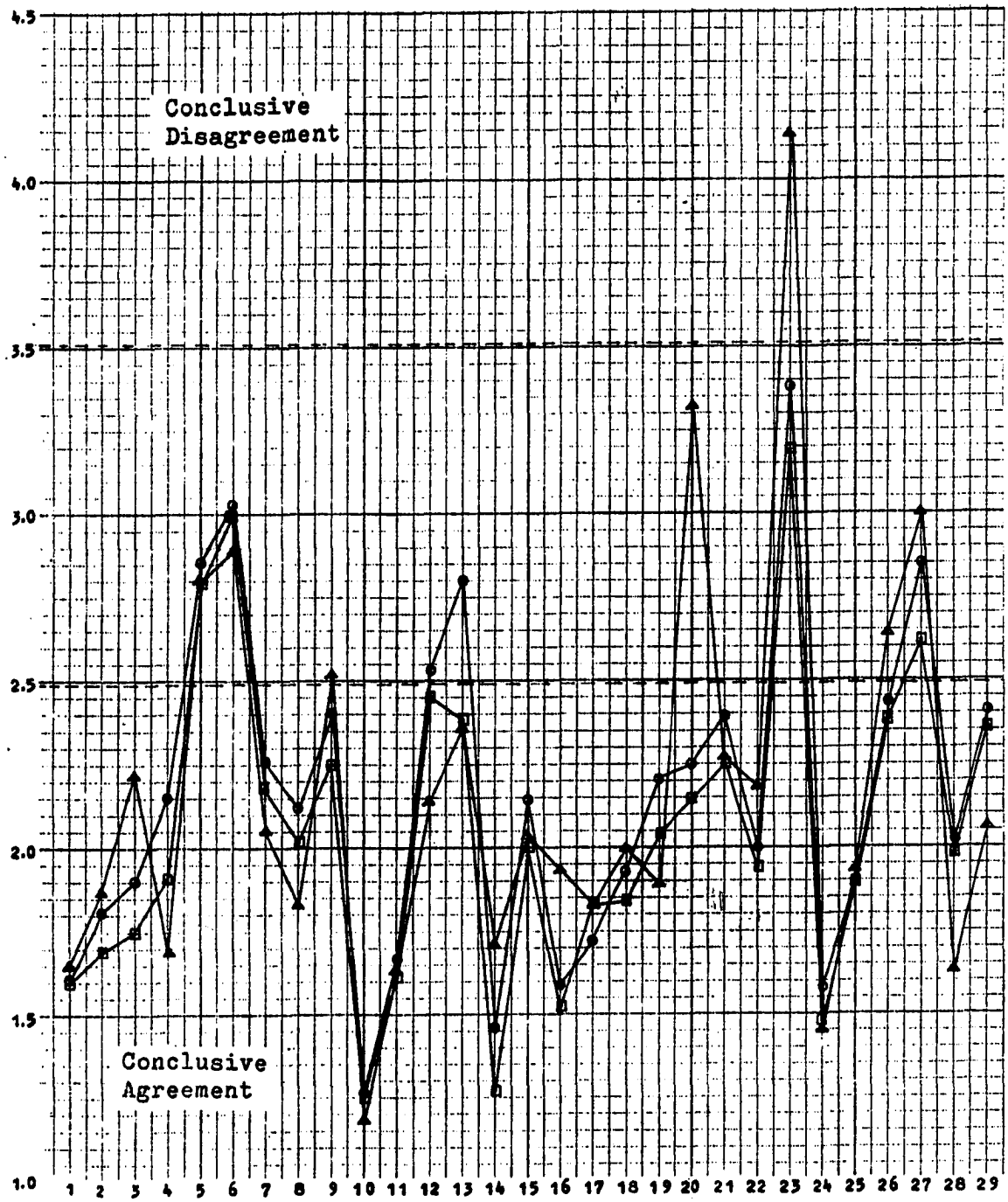
| | Number of Responses | Agree Completely | Tend to Agree | Undecided | Tend to Disagree | Disagree Completely | Ranking Index for all Administrators | Rank According to Index for all Administrators | Ranking Index No Graduate Experience with Item | Ranking Index Graduate Experience with Item |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Cultural courses | 78 | 37 | 36 | 3 | 2 | 0 | 1.62 | 5 | 1.65 | 1.60 |
| 2. In-service credit | 78 | 35 | 29 | 12 | 2 | 0 | 1.76 | 7 | 1.87 | 1.69 |
| 3. Courses in administration | 76 | 37 | 24 | 10 | 3 | 2 | 1.80 | 8 | 2.22 | 1.75 |
| 4. Workshops combining science disciplines | 79 | 31 | 35 | 9 | 3 | 1 | 1.84 | 10 | 1.69 | 1.91 |
| 5. Thesis | 77 | 13 | 24 | 11 | 24 | 5 | 2.79 | 27 | 2.80 | 2.79 |
| 6. Formal science courses | 77 | 11 | 22 | 13 | 20 | 11 | 2.97 | 28 | 2.89 | 3.00 |
| 7. Consumers of science research | 76 | 22 | 33 | 11 | 8 | 2 | 2.14 | 18 | 2.05 | 2.18 |
| 8. Consumers of education research | 75 | 24 | 35 | 10 | 5 | 1 | 1.99 | 14 | 1.83 | 2.02 |
| 9. Graduate practice teaching | 77 | 20 | 27 | 18 | 9 | 3 | 2.32 | 21 | 2.52 | 2.25 |
| 10. Laboratory facilities | 78 | 64 | 12 | 1 | 0 | 1 | 1.23 | 1 | 1.18 | 1.25 |
| 11. Laboratory schools | 77 | 43 | 23 | 8 | 3 | 0 | 1.62 | 5 | 1.63 | 1.62 |
| 12. Flexible program | 78 | 23 | 28 | 9 | 12 | 6 | 2.36 | 22 | 2.14 | 2.45 |
| 13. Require science education research | 78 | 16 | 30 | 22 | 7 | 3 | 2.37 | 23 | 2.36 | 2.38 |

TABLE 8.--Continued

| | Number of Responses | Agree Completely | Tend to Agree | Undecided | Tend to Disagree | Disagree Completely | Ranking Index for all Administrators | Rank According to Index for all Administrators | Ranking Index No Graduate Experience with Item | Ranking Index Graduate Experience with Item |
|---|---|---|---|---|---|---|---|---|---|---|
| 14. Demonstrations in college classes | 78 | 56 | 18 | 3 | 1 | 0 | 1.35 | 2 | 1.71 | 1.27 |
| 15. Elective science education research | 78 | 21 | 37 | 18 | 2 | 0 | 2.01 | 16 | 2.03 | 2.00 |
| 16. Encourage teaching experience | 78 | 49 | 17 | 7 | 4 | 1 | 1.60 | 4 | 1.93 | 1.52 |
| 17. Require teaching experience | 64 | 37 | 10 | 10 | 5 | 2 | 1.83 | 9 | 1.83 | 1.83 |
| 18. Inquiry approach | 77 | 28 | 29 | 19 | 1 | 0 | 1.91 | 12 | 2.00 | 1.84 |
| 19. Elective research in science | 75 | 21 | 35 | 18 | 1 | 0 | 1.99 | 14 | 1.89 | 2.04 |
| 20. Terminal program | 77 | 19 | 25 | 19 | 9 | 5 | 2.43 | 24 | 3.32 | 2.14 |
| 21. Enable pursuit of doctorate | 78 | 24 | 23 | 21 | 7 | 3 | 2.26 | 20 | 2.27 | 2.25 |
| 22. History &/or Philosophy of science | 75 | 28 | 27 | 12 | 6 | 2 | 2.03 | 17 | 2.18 | 1.94 |
| 23. Without awarding master's degree | 77 | 8 | 8 | 14 | 22 | 25 | 3.62 | 29 | 4.14 | 3.19 |
| 24. Specially designed advanced science courses | 76 | 42 | 32 | 2 | 0 | 0 | 1.47 | 3 | 1.45 | 1.48 |

TABLE 8.--Continued

| | Number of Responses | Agree Completely | Tend to Agree | Undecided | Tend to Disagree | Disagree Completely | Ranking Index for all Administrators | Rank According to Index for all Administrators | Ranking Index No Graduate Experience with Item | Ranking Index Graduate Experience with Item |
|---|---|---|---|---|---|---|---|---|---|---|
| 25. Graduate introductory science courses | 75 | 29 | 30 | 12 | 2 | 2 | 1.91 | 12 | 1.93 | 1.89 |
| 26. Mathematics requirement | 75 | 20 | 19 | 22 | 7 | 7 | 2.49 | 25 | 2.64 | 2.38 |
| 27. Calculus for physical science | 76 | 14 | 17 | 25 | 12 | 8 | 2.77 | 26 | 3.00 | 2.62 |
| 28. Ten hours in each area | 77 | 33 | 31 | 6 | 4 | 3 | 1.87 | 11 | 1.63 | 1.98 |
| 29. Institute type program | 75 | 15 | 31 | 27 | 1 | 1 | 2.23 | 19 | 2.06 | 2.36 |




Graph 4.--Ranking indices for opinions of administrators on items 1 through 29 of Part Two.

o——— Value placed on the item in the administrators' experience.
□——— Recommendations by administrators indicating experience with the item.
△——— Recommendations by administrators indicating lack of experience with the item.

For the purpose of analysis, to give an indication of intensity of response, a ranking index of 2.49 or less was taken as indicating conclusive value or agreement with a statement and an index of 3.51 or more was taken as conclusive lack of value or disagreement with a statement. Indices from 2.50 to 3.00 and from 3.00 to 3.50 were taken as indicating inconclusive value or agreement with a statement and inconclusive lack of value or disagreement with a statement.

In the following discussion the statements are listed in rank order based on the ranking indices for all administrators responding presented in Table 8. Those indices were calculated from recommendations of administrators responding to the statements dealing with the graduate education of high school science teachers. The rank order of the statements proceeds from that with the lowest ranking index, denoting most nearly complete agreement with the statement, to that with the highest ranking index, denoting most nearly complete disagreement with the statement.

In addition to an analysis of the responses of the administrators, the responses of all the science teachers of the sample, presented in Table 5, were compared to the responses of the administrators.

The number of responses varies from item to item due to the fact that occasionally a respondent failed to answer an item, but because of their high value the data were kept.

Statement 10.--Provide adequate laboratory facilities so that teachers may have experience working with audio-visual, curriculum, and laboratory materials related to their particular science area.

This statement ranked first with a ranking index for all

administrators of 1.23 which indicated conclusive agreement with the statement. Data in Table 5 show that teachers also ranked this item first with the same ranking index, 1.23. Responses of the administrators who indicated no experience with the statement tended to agree with it slightly more than administrators not indicating experience--index 1.18. Of the 78 administrators responding to the item, 76 or 97.4 per cent agreed or tended to agree with it. Data in Table 7 show that administrators who indicated experience with the item also ranked it number one in value, with a ranking index of 1.27.

Statement 14.--Use instructional methods in college classes which emphasize demonstrations, class participation, and use of audio-visual aids.

Data in Table 8 show that of 78 administrators responding to this statement, 74 or 94.9 per cent agreed or tended to agree with it. The ranking index for all administrators was 1.35. That index gave this statement the rank order two, and conclusive agreement with the item was indicated. Administrators indicating experience with the item tended to agree with it to a greater extent than administrators not having the experience--ranking index 1.27. As shown in Table 7, these same administrators indicated a little less value of the item in their experience, showing a value ranking index of 1.46. The item is ranked second in value however. Data in Table 5 show that teachers ranked this item third, based on the ranking index of 1.41 for their recommendations. They showed only slightly less tendency to agree with the statement than was shown by the superintendents who exhibited an index of 1.35.

Statement 24.--Provide advanced courses in science areas designed

especially for secondary teachers.

This statement was ranked third based on the ranking index of 1.47 for recommendations of all administrators responding. Data in Table 8 show too that there was little difference in the indices for administrators indicating experience with the item and those without experience (indices 1.48 and 1.45). Seventy-four (97.4 per cent) of the 76 administrators responding agreed or tended to agree with the statement, and conclusive agreement with the item was indicated. In Table 7 it will be seen that this item was ranked third in value though the value ranking index for administrators indicating experience with the item was 1.58. Science teachers ranked this item first in value in their experience and second as a recommendation for a graduate program. A ranking index of 1.36 was calculated from the recommendations of all teachers responding. Both teachers and administrators indicated conclusive agreement with the statement.

Statement 16.--Students should be encouraged to have at least one year full-time teaching experience before entering the fifth-year program.

Data in Table 8 show that this item ranked fourth in the recommendations of all administrators responding to the item. Sixty-six (84.6 per cent) of the 78 administrators responding checked agree completely or tend to agree. A ranking index of 1.60 was calculated for the recommendations of administrators, which was interpreted as conclusive agreement with the statement. Administrators who indicated experience with the item tended to agree with it more--ranking index 1.52. Data in Table 7 show a value ranking index of 1.59 and a rank order of four for the value placed on the item in those administrators' experience. Teachers

tended to agree with this item a little less than did administrators. Data in Table 5 show a ranking index of 1.82 and a rank order of eight, but still conclusive agreement with the statement.

Statement 11.--Provide the use of laboratory schools (public or college connected) for demonstration, research, and experimentation.

Administrators ranked this item fifth, based on the ranking index (1.62) for recommendations by all administrators responding. This index was taken to indicate conclusive agreement with the statement. Data in Table 8 show also that administrators with and without experience with the item tended to agree with it to about the same degree. Of 77 administrators responding to the statement, 66 or 85.7 per cent agreed or tended to agree with it. An index of 1.67 was calculated (Table 7) for value placed on the item in the experience of the administrators. Based on this index, the item was given a value rank order of six. Science teachers responding to this item gave it a rank order of four based on the ranking index of 1.68 (Table 5). This was in rather close agreement with the index of 1.62 for the recommendations for the administrators.

Statement 1.--Provide teachers of high school science with an opportunity to improve their cultural backgrounds by taking some work in cultural fields outside the science and professional education fields.

Data in Table 8 show that this item also was given the ranking index 1.62 which gave it a tie rank order of five with the previous statement. This index of 1.62 was taken as conclusive agreement with the statement by administrators. Of the 78 administrators responding to the statement, 73 or 93.7 per cent agreed or tended to agree with it.

Administrators who indicated experience with the item tended to agree with it slightly more than those without experience, showing an index of 1.60. Data in Table 7 show the ranking index for value placed on the item by those administrators to be 1.61, which is in close agreement with the other indices. The rank based on value in the graduate program of the administrators was 5 also. As shown in Table 5, science teachers did not agree with this statement to the same extent as administrators. The ranking index 2.27 was calculated for recommendations by all the teachers and the item ranked nineteenth. However, this index was taken to indicate conclusive agreement with the statement, as was the 1.62 calculated for administrators.

Statement 2.--Provide in-service courses for individual or group study of local science education problems for which credit is received.

This statement ranked seventh. The ranking index of 1.76 was taken to indicate conclusive agreement with the statement by the administrators. The data in Table 8 show that 64 (82.1 per cent) of the 78 administrators responding to the item checked agree completely or tend to agree. Slightly over 15 per cent of the respondents were undecided. Administrators who had had experience with the item tended to agree with it more than those without experience, showing a ranking index of 1.69. In Table 7 it will be seen that the item was ranked eighth in value by the administrators indicating experience. Those responses gave a ranking index of 1.81. This statement was ranked eighth by science teachers (Table 5), which was in rather good agreement with the rank based on recommendations of administrators. The ranking index for recommendations of all teachers responding was 1.82.

Statement 3.--Provide a general course in school administration for a better understanding of the job of the school superintendent or principal.

Administrators ranked this item eighth as a recommendation for the graduate program of the high school science teacher. The ranking index of 1.80 was taken as conclusive agreement with the statement. Sixty-one (80.3 per cent) of the 76 administrators responding to the statement agreed or tended to agree with it. Those administrators indicating experience with the item showed a ranking index of 1.75 for their recommendation but an index of 1.90 for the value of the item in their experience. Of the science teachers, 60.5 per cent agreed or tended to agree with the statement (Table 5); they agreed with the statement considerably less than did administrators, giving it a ranking index of 2.42 and a rank of twenty-three. However, teachers who indicated experience with the statement gave it an index of 2.22.

Statement 17.--Students should be required to have at least one year of full-time teaching experience before entering the fifth-year program.

Data in Table 8 show that 73.4 per cent of the 64 administrators responding to this statement agreed or tended to agree with it. The rank order of the statement was nine and the ranking index for the administrators responding was 1.83. This was interpreted as conclusive agreement with the statement. The same ranking index (1.83) was calculated for those administrators who indicated experience with the item and for those without the experience. Twelve of the administrators would require more than one year of teaching experience. The range of the suggestions

was from two to five years and the mean was 3.2 years. Data in Table 7 show the index based on the value attached to the item in the administrators' experience to be 1.72. Of the administrators responding to the item, 38.46 per cent indicated no experience with it in their graduate work. Science teachers (Table 5) agreed with this statement to a lesser extent than did administrators, showing an index of 2.33 and a rank of twenty-one. The index was taken as conclusive agreement with the statement however.

Statement 4.--Provide workshops that combine the scientific disciplines for a better understanding of their interdependence.

This statement ranked tenth. Of the 79 adminsitrators responding to the statement, 66 (83.5 per cent) agreed or tended to agree with it. A ranking index of 1.84 was determined for the statement, which indicated conclusive agreement with it. The respondents not indicating experience with the item tended to agree with it more than those with the experience, showing an index of 1.69. Data in Table 7 show that administrators who indicated experience with the item exhibited a value ranking index of 2.15 for it and ranked it sixteenth. This was contrasted with an index of 1.91 and a rank twelve for their recommendation for a science teacher's graduate program. Data in Table 5 show that science teachers also ranked this item tenth in their recommendations and showed a ranking index of 1.83. That was in very good agreement with the response of the administrators.

Statement 28.--Require the completion (undergraduate or postgraduate) of a minimum of 10 semester hours in each of the following (regardless of the major science area): biology, chemistry, and physics.

Data in Table 8 show that of the 77 administrators responding to this statement, 64 or 83.1 per cent agreed or tended to agree with it. The ranking index for all administrators responding was 1.87 and the rank order of the statement was eleven. Administrators not indicating experience with the item tended to agree with it more than did administrators indicating experience; the indices were 1.63 and 1.98. The administrators with experience showed an index of 2.02 for the value of the item in their experience. The ranking index for all the administrators was taken to indicate conclusive agreement with the item. Data in Table 5 show that science teachers were also in conclusive agreement with the statement but to a greater degree, showing a ranking index of 1.69. The item ranked fifth in the recommendations of science teachers for a graduate program.

Statement 25.--Provide introductory courses in science which are related to his major area and which offer graduate credit, without prerequisites, and are prepared especially for secondary teachers.

This statement ranked twelfth. The ranking index for all administrators responding was 1.91 which was taken as conclusive agreement with the statement. Of 75 administrators responding to the statement, 59 or 78.8 per cent agreed or tended to agree with it. Those administrators indicating experience with the statement tended to agree slightly more (index 1.89). In Table 7, the administrators showed an index of 1.90 for the value of the item in their experience. Also, the item ranked ninth in value assigned. The teacher response to the same statement, shown in Table 5, was more in agreement with it, showing a ranking index of 1.72. The statement ranked sixth in recommendations by science teachers. They too indicated conclusive agreement with the statement.

Statement 18.--Include at least one science course taught by the inquiry or discovery approach.

Data in Table 8 show this statement also had a ranking index of 1.91, giving it a tie rank order of twelve with item 25. Of 77 administrators responding, 57 or 74.0 per cent agreed or tended to agree with the statement and only one tended to disagree. The data were interpreted as conclusive agreement with the statement. Those administrators who indicated experience with the item tended to agree with it more, showing an index of 1.84. The index for value placed on the item in their experience was 1.93 (Table 7). This index gave the item the rank of eleven in value. Approximately 43 per cent of the administrators indicated no experience with the item. Data in Table 5 show that science teachers agreed with this statement to a greater degree than did administrators. The teachers showed a ranking index of 1.77 and a rank of seven for this statement. Both administrators and teachers showed conclusive agreement with this statement as a recommendation for the graduate education of the secondary school science teacher.

Statement 8.--Emphasize educational research from the point of view of preparing teachers to become intelligent consumers of such research.

This statement showed a ranking index of 1.99 and was ranked fourteenth by administrators (Table 8). That index was taken as conclusive agreement with the statement. Agree completely or tend to agree was checked by 78.7 per cent of the administrators responding to this statement. Those administrators who indicated experience with the item tended to agree with it less (index 2.02) than administrators not indicating

experience (index 1.83). The ranking index for value placed on the item in the administrators' experience was 2.12 (Table 7). Data in Table 5 show that science teachers tended to agree with the statement less (index 2.31) than administrators ((index 1.99) but both showed conclusive agreement with the item. Teachers ranked this item twentieth.

Statement 19.--Encourage research in a science area for credit on an elective basis.

This statement also showed a ranking index of 1.99 and was given a tie rank order of fourteen with statement 8. Of the 75 administrators responding to the statement, 56 or 74.7 per cent agreed or tended to agree with it, one person tended to disagree, and none disagreed completely. Those administrators not indicating experience with the item tended to agree with it more--ranking index 1.89. Administrators who indicated experience with the item show an index of 2.21 (Table 7) for the value of the item in their experience and ranked it seventeenth in value. Data in Table 5 show that science teachers tended to agree with this statement more (index 1.86) than did administrators (index 1.99). Both, however, indicated conclusive agreement with the statement. The item ranked eleventh based on teacher responses.

Statement 15.--Provide for research in science education to be taken for credit on an elective basis.

This statement ranked sixteenth and showed a ranking index of 2.01. This index was taken as conclusive agreement with the statement. Of the 78 administrators responding to the item, 58 or 74.4 per cent agreed or tended to agree with it. Administrators who had experience with the item showed only slightly more tendency to agree with it (index

2.00) than did those without the experience (index 2.03). Data in Table 7 show that the value placed on the item in the administrators' experience (index 2.14) was not as great as their tendency to agree with the item for the graduate program of the secondary school science teacher. Of the 79 respondents to the statement in Table 7, 44.30 per cent indicated no experience with it in their graduate work. Science teachers (Table 5) tended to agree with this statement to a greater extent than did administrators. Teachers showed a ranking index of 1.89 and a rank order of twelve for the item. Both indices, 2.01 and 1.89, were taken as indicating conclusive agreement with the statement.

Statement 22.--Include a course in the history and/or philosophy of science.

Data in Table 8 show that of the 75 administrators responding to this item, 55 or 73.3 per cent agreed or tended to agree with it. The statement showed a ranking index of 2.03, which was taken to indicate conclusive agreement, and a rank of seventeen. Administrators who indicated experience with the item tended to agree with it more than those without the experience--indices 1.94 and 2.18. The value placed on the item in the administrators' experience (Table 7) showed an index of 2.00 and a value rank for the item of twelve. Science teachers (Table 5) tended to agree with the statement slightly more than did the administrators--index 1.98. The item ranked thirteenth in the recommendations of the teachers. The indices indicated conclusive agreement with the statement.

Statement 7.--Emphasize scientific research from the point of view of preparing teachers to become intelligent consumers of such research.

Data in Table 8 show that this statement ranked eighteenth. Of the 76 administrators responding to the statement, 55 or 72.4 per cent agreed or tended to agree with it. The ranking index of 2.14 was taken to indicate conclusive agreement with the statement. Administratrors not indicating graduate experience with the item tended to agree with it more--index 2.05. The item ranked nineteenth based on the value administrators placed on the item in their experience (Table 7). In Table 5 the data show that science teachers tended to agree with the statement more than did the administrators--index 2.05. The teachers ranked the item fifteenth in their recommendation. Conclusive agreement with the statement was indicated by both administrators and teachers.

Statement 29.--Include programs designed outside the regular class structure patterned after NSF Institute type programs but not necessarily nationally sponsored with participant stipends.

This statement ranked nineteenth. Of the 75 administrators responding to the item, 46 or 61.3 per cent agreed or tended to agree with it. Only one person disagreed completely and one tended to disagree but 27 (36 per cent) were undecided. The statement showed a ranking index of 2.23 which was interpreted as conclusive agreement. Administrators not indicating experience with the item tended to agree with it more--index 2.06. Data in Table 7 show that 56.42 per cent of the 78 administrators responding indicated experience with the item. They showed a ranking index of 2.41 and a rank of twenty-two for the value of the item in their experience. That was in good agreement with their recommendations for the graduate program of science teachers (index 2.36). The science teachers (Table 5) tended to agree with this statement more than did

administrators, showing a ranking index of 2.04 and a rank of fourteen.

Statement 21.--So design the program that its completion will enable a person to pursue the doctorate in science education.

Data in Table 8 show that this item was ranked twentieth and had a ranking index of 2.26 based on responses of all the administrators. Of the 78 administrators responding to the statement, 47 or 60.3 per cent agreed or tended to agree with it. There was little difference in the responses of the administrators who had had experience with the item and those who had not--indices 2.25 and 2.27. Administrators who indicated experience with the item tended to agree with it as a recommendation for science teachers (index 2.25) more than they valued it in their own experience (index 2.39). The item was ranked twentieth in value by those administrators (Table 7). This item was ranked seventeenth in the recommendations of high school science teachers (Table 5). Those teachers tended to agree with the statement to a greater extent than the administrators--indices 2.06 and 2.26. Both the indices indicate conclusive agreement with the statement.

Statement 9.--Provide opportunities for the teacher to apply and extend his professional competence through directed practice teaching at the graduate level.

Forty-seven (61.0 per cent) of the 77 administrators responding to this statement agreed or tended to agree with it (Table 8). The statement ranked twenty-first and showed a ranking index of 2.32. This index was taken as conclusive agreement with the statement. Administrators who indicated graduate experience with the item tended to agree with it more than those without the experience--ranking index 2.25.

Based on the value those administrators assigned the item in their experience (Table 7), an index of 2.40 was calculated and the item was also ranked twenty-first. Science teachers (Table 5) showed less tendency to agree with the item than did administrators, showing an index of 2.48 that was near the limits of conclusive agreement. Teachers who had experience with the item showed an index of 2.31 and conclusive agreement with it. The rank of the item for all teachers responding was twenty-four.

Statement 12.--A flexible program with few specific course requirements in either science or education so that a teacher may elect those courses which best meet his needs.

Data in Table 8 show this item ranked twenty-second based on the ranking index of 2.36 for the recommendations of all administrators responding to the statement. This index was taken as conclusive agreement with the statement. Of the 78 administrators responding to the item, 51 or 65.4 per cent agreed or tended to agree with it. Those administrators who did not indicate experience with the item tended to agree with it more--index 2.14. Those administrators who indicated experience with the item show a ranking index of 2.45 and assigned even less value to the item in their experience, showing a value ranking index of 2.53 (Table 7). The item ranked twenty-fourth in value. Data in Table 5 show that science teachers tended to agree with the item more than did administrators--ranking index 2.05. And teachers indicating experience with the item showed a ranking index of 1.91 in contrast to 2.45 for administrators with experience. The overall ranking indices for both administrators (2.36) and teachers (2.05) were taken as conclusive

agreement with the statement. Teachers ranked the item fifteenth.

Statement 13.--Require that the graduate student conduct a research project in science education.

This statement ranked twenty-third. Data in Table 8 show a ranking index of 2.37 which was taken to indicate conclusive agreement with the statement. Forty-six (59.0 per cent) of the 78 administrators responding to the item agreed or tended to agree with it and 28.2 per cent were undecided. There was little difference in the indices for administrators with and without experience with the item--indices 2.38 and 2.36. The value placed on the item in the experience of those administrators, however, showed an index of 2.80. That indicated inconclusive value. Science teachers tended to agree with the statement even less than administrators, showing a ranking index of 2.86 and a rank order of twenty-seven. While the ranking index shown by administrators (2.37) was taken as conclusive agreement, the index shown by teachers (2.86) was taken as inconclusive agreement.

Statement 20.--The fifth year should be a terminal program independent of providing prerequisites for doctoral study.

This statement ranked twenty-fourth in recommendations of administrators. Data in Table 8 show a ranking index of 2.43 which was interpreted as conclusive agreement with the statement. Of the 77 administrators responding to the statement, 44 or 57.1 per cent agreed or tended to agree with it. Administrators who had experience with the item tended to agree with it more--index 2.14. Those administrators showed a ranking index of 2.25 for the value of the item in their experience (Table 7). Those same administrators showed a value rank order of

eighteen for the item. Science teachers exhibited less tendency to agree with the item (Table 5) than did administrators. Teachers showed a ranking index of 2.81 and a rank order of twenty-six. The overall index for teachers was taken to indicate inconclusive agreement with the statement.

Statement 26.--The completion of the fifth year should have as a prerequisite the completion of mathematics through algebra, trigonometry, and analytical geometry either as an undergraduate or postgraduate.

Data in Table 8 show that 39 or 52.0 per cent of the 75 administrators responding to the statement agreed or tended to agree with it and 29.3 per cent were undecided. This statement ranked twenty-fifth and showed a ranking index of 2.49 for the recommendations of all the administrators responding. That index was at the limit of conclusive agreement with the statement. Administrators who indicated experience with the item tended to agree with it more--ranking index 2.38. The ranking index for the value they placed on the item in their experience was 2.43 and the item ranked twenty-third in value (Table 7). Almost 43 per cent of the administrators indicated no experience with the item. Science teachers tended to agree with the statement more, showing an index of 2.24 and conclusive agreement; and science teachers indicating experience with the item tended to agree even more, showing a ranking index of 2.05.

The following three statements received ranking indices of from 2.50 to 3.00, which was interpreted as inconclusive agreement.

Statement 27.--The completion of the fifth year should have as a prerequisite the completion of mathematics through two semesters of

calculus either as undergraduate or postgraduate work for the physical science major.

This statement ranked twenty-sixth. Of the 76 administrators responding to the item, 31 or 40.8 per cent agreed or tended to agree and 32.9 per cent were undecided. The statement showed a ranking index of 2.77 for all administrators responding. This was taken as inconclusive agreement with the statement. Those indicating experience with the item tended to agree with it more, showing a ranking index of 2.62. The ranking index for value placed on the item in the experience of the administrators was 2.85 and the statement ranked twenty-sixth (Table 7). Responses of science teachers gave this item a ranking index of 2.80 and a rank of twenty-five for their recommendations (Table 5). This was in good agreement with the recommendations of the administrators.

Statement 5.--Require the completion of a thesis for the master's degree.

Data in Table 8 show that the responses of the administrators to this recommendation for the graduate education of the high school science teacher gave it a ranking index of 2.79 and a rank of twenty-seven. This index was taken to indicate inconclusive agreement with the statement. Of the administrators responding to the item, 48.1 per cent agreed or tended to agree with the statement and 37.7 per cent disagreed or tended to disagree with it. There was little difference in the indices shown for administrators with and without experience with the item--indices 2.79 and 2.80. In terms of value placed on the item in the experience of the administrators, data in Table 7 show an index of 2.86 and a rank order of 27. Data in Table 5 show that the response of the science

teachers was inconclusive--ranking index 3.00. The rank of the item was twenty-eight based on the responses of teachers.

Statement 6.--Provide formal science courses which place emphasis on theoretical knowledge and technical skills without reference to classroom teaching.

The ranking index for all administrators responding to the statement was 2.97 which was near the limit for inconclusive agreement. The statement ranked twenty-eighth. Administrators not indicating experience with the item tended to agree with it slightly more, showing a ranking index of 2.89. Data in Table 7 show the item also ranked twenty-eighth in value in the experience of administrators. Science teachers showed a greater tendency to agree with the statement, showing a ranking index of 2.34 (Table 5). This was interpreted as conclusive agreement with the statement. The rank of the item based on that index was twenty-two.

Statement 23.--The fifth year should be considered a fifth year of teacher education without awarding a master's degree.

This statement ranked twenty-ninth. The ranking index of 3.62 was taken as conclusive disagreement with the statement. Administrators who indicated no experience with the item disagreed with it more strongly, showing an index of 4.14. Of the 77 administrators responding to the item, 47 or 61.0 per cent disagreed or tended to disagree with the statement. Administrators who indicated experience with the item showed a ranking index of 3.19 and inconclusive disagreement with the statement. They also showed inconclusive value for the item in their experience with an index of 3.38. The item also ranked twenty-ninth in value. Data

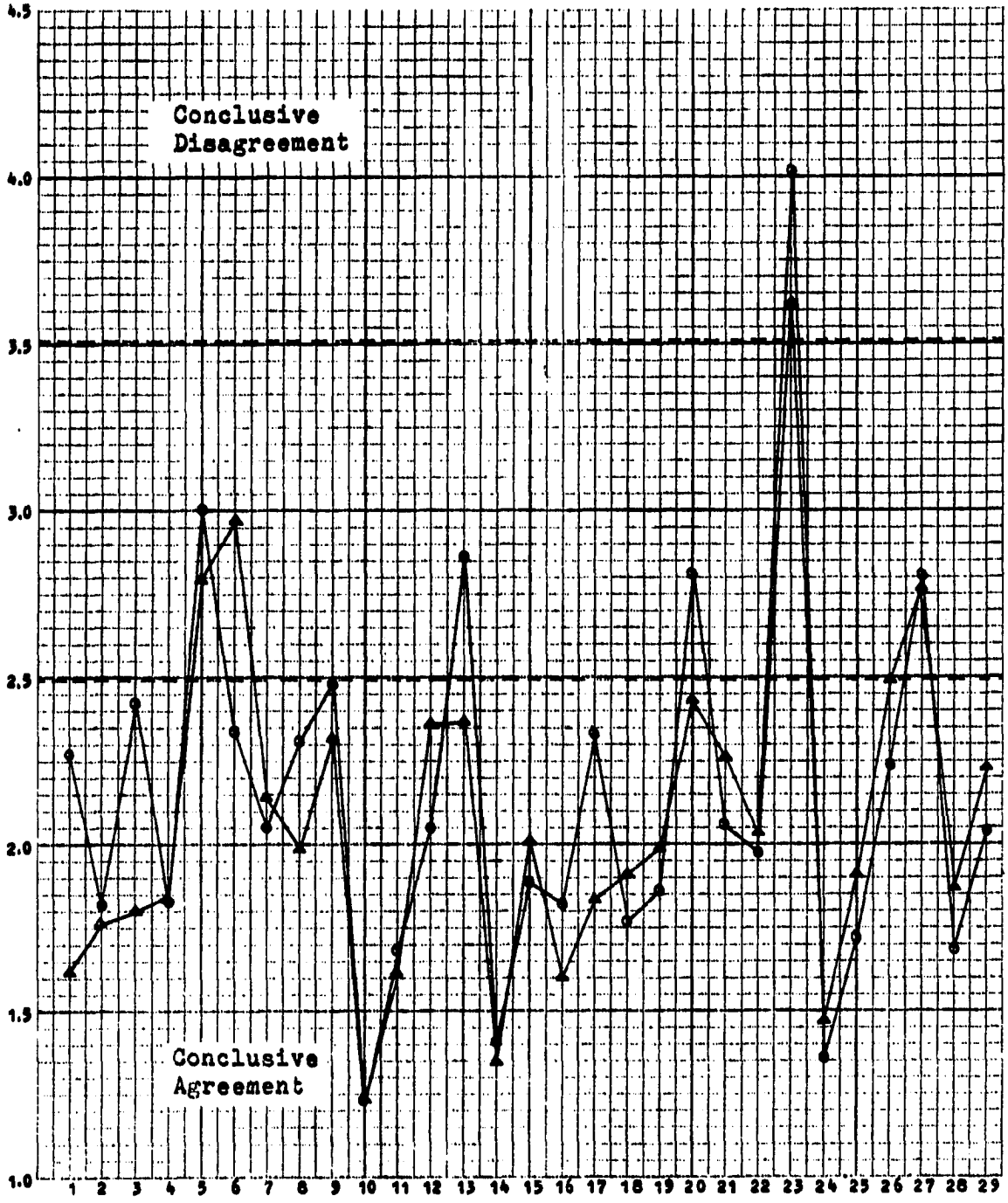
in Table 5 show that science teachers disagreed with the statement to a greater extent than did administrators. They showed a ranking index of 4.01 and conclusive disagreement with the statement. Both administrators and teachers ranked this item last and indicated conclusive disagreement with the statement.

The data presented relative to the responses of administrators and high school science teachers to items 1 through 29 showed that a consensus on most items was attained. This fact is graphically illustrated in Graph 5 where the ranking indices for responses of administrators to items 1 through 29 and those for responses of high school teachers are plotted.

## Analysis of Responses of Science Teachers and Administrators to Items 30 and 31 of Part Two

Items thirty and thirty-one deal with the percentage of the total fifth-year program of the high school science teacher to be devoted to various areas. The responses in each of the areas were tabulated and the means determined. That data for high school science teachers will be seen in Table 9 and that for administrators in Table 10. Since the responses could have been affected by the number of different subject areas or courses taught, items thirty and thirty-one for the teachers were analyzed on the basis of responses of teachers teaching a single course, those teaching two different courses, and those teaching more than two different courses or general science.

Item 30.--What percentage of the total fifth-year program should be devoted to each of the following: (1) Professional education courses, (2) Science in the major science area, (3) Other science courses,




Graph 5.--Ranking indices for opinions of teachers and administrators on items 1 through 29 of Part Two.

o——— Recommendations of all teachers.
Δ——— Recommendations of administrators.

TABLE 9.--Responses of Science Teachers, Recorded on the Basis of the Number of Different Courses Taught, to Items 30 and 31 of Part Two Concerning the Percentage of the Total Fifth-Year Program to be Devoted to Various Areas of Study and Whether a Science Subject Major Should be Required

| No. | Statement | One Course Taught | | Two Courses Taught | | More than Two Courses Taught | | Overall Percentage |
|---|---|---|---|---|---|---|---|---|
| | | Number of Responses | Percentage of Program | Number of Responses | Percentage of Program | Number of Responses | Percentage of Program | |
| 30. | What percentage of the total program should be devoted to: | 65 | | 39 | | 157 | | |
| | Professional education | | 6.67 | | 7.82 | | 9.61 | 8.62 |
| | Major science area | | 49.49 | | 48.18 | | 44.60 | 46.34 |
| | Other science | | 13.65 | | 17.06 | | 15.20 | 15.11 |
| | Science education | | 7.36 | | 7.56 | | 9.46 | 8.65 |
| | Research | | 7.25 | | 5.97 | | 6.02 | 6.32 |
| | Observation and student teaching | | 4.48 | | 4.41 | | 4.82 | 4.68 |
| | Electives | | 9.93 | | 8.15 | | 8.97 | 9.08 |
| | Other | | 1.15 | | 0.90 | | 1.28 | 1.19 |
| 31. | Should a science subject major be required? | | | | | | | |
| | Yes | 52 | 54.37 | 27 | 49.44 | 99 | 44.84 | 48.32 |
| | No | 11 | | 12 | | 57 | | |

TABLE 10.--Responses of Administrators, with Percentages, to Items 30 and 31 of Part Two Concerning the Percentage of the Total Fifth-Year Program to be Devoted to Various Areas

| Number | Statement | Number of Responses | Program Percentage |
|---|---|---|---|
| 30 | Percent of the total program that should be devoted to: | 75 | |
| | Professional education | | 14.07 |
| | Major science area | | 41.53 |
| | Other science | | 10.87 |
| | Science education | | 8.47 |
| | Research | | 8.39 |
| | Observation and student teaching | | 5.64 |
| | Electives | | 10.19 |
| | Other | | 0.82 |
| 31 | Should science subject major be required: | | |
| | Yes | 48 | 30.94 |
| | No | 31 | |

(4) Science education courses, (5) Research, (6) Observation and advanced student teaching, (7) Unrestricted electives, and (8) Other required work.

The percentages shown in Tables 9 and 10 are the means of the percentages indicated by the respondents. The data in Table 9 show that in the opinion of teachers 61.45 per cent of the graduate program should be devoted to science courses. Teachers teaching a single science indicated more emphasis in the major science area, showing 49.49 per cent. Those teaching two courses called for 48.18 per cent in the major science area and those teaching more than two courses or general science designated the least, 44.60 per cent. Teachers teaching only one course called for an additional 13.65 per cent of the program to be in other science

(total science 63.14 per cent); those teaching two science courses called for 17.06 per cent in other science (total science 65.24 per cent); and those teaching more than two courses called for 15.20 per cent (total science 59.80 per cent). The greatest total science emphasis was indicated by those teachers teaching two courses, who called for 65.24 per cent of the program to be science. Administrators (Table 10) indicated a lesser science requirement, calling for 52.40 per cent of the graduate program to be science. Unrestricted electives received an over-all per cent of 9.08 from teachers, with those teaching one course favoring more. Administrators assigned this item 10.19 per cent. The next in emphasis from teacher responses were science education (8.65 per cent) and professional education (8.62 per cent). Teachers teaching more courses designated more professional education. Administrators assigned to the same areas 8.47 per cent and 14.07 per cent. The 14.07 per cent for professional education was significantly more than the 8.62 per cent called for by teachers. The remaining areas were research (6.32 per cent), observation and student teaching (4.68 per cent) and other (1.19 per cent). Mathematics was suggested by some teachers. Administrators gave the items the same order but called for 8.39 per cent to be devoted to research.

Item 31.--Should a science speciality such as chemistry, physics, or biology be required as part of the fifth-year program?

The data in Table 9 show that about 83 per cent of the teachers teaching one course, about 69 per cent of the teachers teaching two courses, and about 63 per cent of the teachers teaching more than two courses thought a science subject major should be required. The

percentage to be devoted to the major varied in a like manner, from 54.37 per cent indicated by teachers teaching one course to 44.84 per cent indicated by teachers teaching more than two courses. About 61 per cent of the administrators thought a science subject major should be required and they would require less of the program to be in the major (30.94 per cent). The mean percentage indicated by teachers was 48.32 per cent.

### Analysis of Responses of Science Teachers and Administrators to Items 32, 33, and 34 of Part Two

Items thirty-two and thirty-three pertained to the teaching of advanced methods courses and item thirty-four pertained to the need for change at the college level to better prepare the high school science teacher for new high school science programs. The responses to those items were reported as number of responses and as percentages. The responses of teachers to those items were considered in respect to the number of years teaching experience of the science teacher to see if there was any marked difference in the responses of those groups of teachers. The data from teacher responses will be seen in Table 11 and the data from administrator responses will be seen in Table 12.

Item 32.--Advanced methods courses in science teaching (improvement of instruction courses) should be offered by the (1) education department giving credit in education, (2) science department giving credit in science, (3) either education or science department giving credit in either, or (4) other.

Of the 264 science teachers responding to this item, 145 or 54.92 per cent indicated a science department should conduct the methods course. Teachers with less than 7 years experience responded to this choice a

TABLE 11.--Responses of Science Teachers and Percentage of Responses to Items 32, 33, and 34 of Part Two Concerning the Methods Courses in Science Teaching and the New Science Programs

| Number | Statement | 1-6 Years Experience | | 7 or More Yrs. Experience | | Overall Percentage |
|---|---|---|---|---|---|---|
| | | Number of Responses | Percentage | Number of Responses | Percentage | |
| 32. | Methods courses in science teaching should be offered by: | 47 | | 217 | | |
| | Education department | 1 | 2.13 | 10 | 4.61 | 4.17 |
| | Science department | 28 | 59.57 | 117 | 53.92 | 54.92 |
| | Either science or education department | 16 | 34.04 | 80 | 36.87 | 36.36 |
| | Other[a] | 2 | 4.26 | 10 | 4.61 | 4.55 |
| 33. | Background of teacher of methods course in science teaching: | 47 | | 219 | | |
| | Professional education | 0 | 0.00 | 2 | 0.91 | 0.75 |
| | Science | 19 | 40.43 | 61 | 27.85 | 30.08 |
| | Combination of science and education | 25 | 53.19 | 150 | 68.49 | 65.79 |
| | Other[b] | 3 | 6.38 | 6 | 2.74 | 3.38 |
| 34. | Need for changes in science at the college level, to prepare teachers for new programs: | 46 | | 188 | | |
| | Yes | 36 | 78.26 | 122 | 64.89 | 67.52 |
| | No | 10 | 21.74 | 66 | 35.11 | 32.48 |

TABLE 11.--Continued

| Number | Statement | 1-6 Years Experience | | 7 or More Yrs. Experience | | Overall Percentage |
|---|---|---|---|---|---|---|
| | | Number of Responses | Percentage | Number of Responses | Percentage | |
| | Have had instruction in <u>new</u> science programs: | 47 | | 213 | | |
| | Yes | 30 | 63.83 | 98 | 46.01 | 49.23 |
| | No | 17 | 36.17 | 115 | 53.99 | 50.77 |

[a]Science education department, science department with science education credit, science department with education credit, team from both departments, science education specialist from both departments, and both departments in cooperation with high school science teachers and high school students.

[b]Combination with high school science teaching experience.

TABLE 12.--Responses of Administrators and Percentage of Responses to Items 32, 33, and 34 of Part Two Concerning the Methods Courses in Science Teaching and the New Science Programs

| Number | Statement | Number of Responses | Percentage |
|---|---|---|---|
| 32. | Methods courses in science teaching should be offered by: | 79 | |
| | Education department | 8 | 10.13 |
| | Science department | 30 | 37.97 |
| | Either | 40 | 50.63 |
| | Other[a] | 1 | 1.27 |
| 33. | Background of teacher of methods course in science teaching: | 79 | |
| | Professional education | 4 | 5.06 |
| | Science | 10 | 12.66 |
| | Combination of science and education | 63 | 79.75 |
| | Other[b] | 2 | 2.53 |
| 34. | Need for changes in science, at the college level, to prepare teachers for new programs: | 70 | |
| | Yes | 25 | 35.71 |
| | No | 45 | 64.29 |
| | Have had instruction in new science programs: | 80 | |
| | Yes | 10 | 12.50 |
| | No | 70 | 87.50 |

[a]Science department with science education credit.

[b]Combination with secondary school science teaching experience.

little more strongly. Of the 79 administrators responding to this item, 30 or 37.97 per cent selected a science department to teach the course. Ninety-six (36.36 per cent) of the science teachers and 50.63 per cent

of the administrators indicated either department might teach the methods course. Only one teacher with six years or less experience and ten with seven or more years experience indicated the education department should teach the methods course. While 4.17 per cent of the teachers selected the education department, 10.13 per cent of the administrators chose that department to teach the course. Of the teachers, 4.55 per cent made other selections among which were science education, combination of science and education, and utilize high school teachers and students.

Item 33.--Which of the following types of backgrounds would best suit a person to teach the advanced methods course? The choices were (1) predominately professional education, (2) predominately science, (3) combination of science and education, or (4) other.

Of the teachers responding to this item, 65.79 per cent indicated that the teacher of advanced methods courses should have a background in science and education. Teachers with more experience expressed this choice more strongly (68.49 per cent). Administrators also preferred this choice with 79.75 per cent of them indicating that a person with a combination of science and education should teach the methods course. A person with a predominately science background was selected by 30.08 per cent of the teachers and only 12.66 per cent of the administrators. Teachers with less experience made this choice more frequently. Only two teachers (0.75 per cent) and four administrators (5.06 per cent) indicated a person with a predominately professional education background should teach the methods course. The choice of a background in science and education was a logical selection and one for which the science education specialist is peculiarly suited. Nine teachers (3.38 per cent)

and two administrators (2.53 per cent) specified the teacher should have high school science teaching experience.

Item 34.--Do you recognize any felt need for program changes in science, at the college level, to better insure that the high school teacher of science can better handle the new science programs, for example CBA or CHEM Study chemistry, PSSC physics, BSCS bioloby, or other?

Data in Table 11 show that 67.52 per cent of the teachers who responded to the item indicated a need for change. Teachers with less experience responded more strongly with 78.26 per cent of the 46 answering the question indicating a need for some change. Much less feeling for change was expressed by administrators with 35.71 per cent indicating a need for change. A larger percentage (63.83) of the teachers with less than seven years teaching experience had had instruction in one of the new science programs than had teachers with more experience (46.01 per cent). Only 12.50 per cent of the administrators had had such instruction.

Teachers and administrators made a number of pertinent suggestions. The most commonly expressed needs could be summed up as the need to (1) develop college courses to prepare high school teachers to teach new programs, (2) use "new" methods, such as inquiry, in some regular courses, and (3) offer courses to better prepare high school teachers to teach high school science laboratories.

### Analysis of Responses of Science Teachers and Administrators to Part Three Concerning Course Offerings

Part Three of the questionnaires was made up of four groups of courses. The first three groups consisted of specific courses that

might be included in the fifth year of science education for the high school science teacher. Group IV provided the respondent an opportunity to list specific science courses he thought would be of most value in the graduate education of a high school science teacher. While the courses listed in those groups do not exhaust all possibilities, they should provide a satisfactory range.

Within each group the respondents were asked to rank the courses on the basis of their importance in the fifth-year of science education for the high school science teacher. The courses were to be ranked from most important (rank 1) to least important (rank 3 for group I, rank 12 for group II, and rank 8 for group III).[2] They were also asked to indicate those courses they had taken as a graduate or as an undergraduate. Group IV was treated separately because of the open ended nature of those responses.

The opinions of respondents might be affected by a number of factors such as teaching experience, educational background, and number of different courses taught. The rankings were, therefore, analyzed on the basis of whether the course had been taken, number of years teaching experience, and number of hours of graduate science to see if there were any marked differences between the responses in those categories.

In order to obtain a mean ranking for each course in the first three groups which could be compared with mean rankings of other courses, ranking indices were obtained within each group of courses. A value of one was assigned to a rank of one, a value of two was assigned to a rank

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[2]See questionnaires in the Appendix for identification of the various groups.

of two, and so on. Those values were totaled for each course and each total was divided by the number of responses to that course in order to obtain a mean ranking index for the course. The courses were ranked within each group by giving the course with the ranking index nearest one the rank of one, the next nearest to one a rank of two, and so on.

Rank and ranking indices for courses in groups I, II, and III are summarized in Tables 13 and 14. Data from responses of high school science teachers to courses in those groups are presented in Table 13. The rank shown for a course in a group was based on the ranking index for all teachers ranking that course. Data from responses of administrators are shown in Table 14. They show ranking indices based on responses of all administrators responding to each course and the rank of the course in a group based on those indices. The data are presented graphically in graphs 6, 7 and 8. In graph 6 the overall ranking indices calculated from responses of teachers to courses in group I are presented along with indices calculated from responses of administrators. Graph 7 relates overall indices for courses in group II and graph 8 relates overall indices for courses in group III.

The responses relative to each course are analyzed below.

## Group I

Utilization of audio-visual materials was ranked first in group I by both teachers (index 1.66) and administrators (index 1.49). Administrators appeared to respond a little more favorably to the course than did teachers. Teachers who had taken the course, those with less than 7 years experience, and those with less than 21 hours of graduate science

TABLE 13.--Analysis of Opinions of Science Teachers Concerning Courses for the Fifth Year with Ranking Indices, Rank of the Course, and Dependence on Experience and Amount of Science Taken

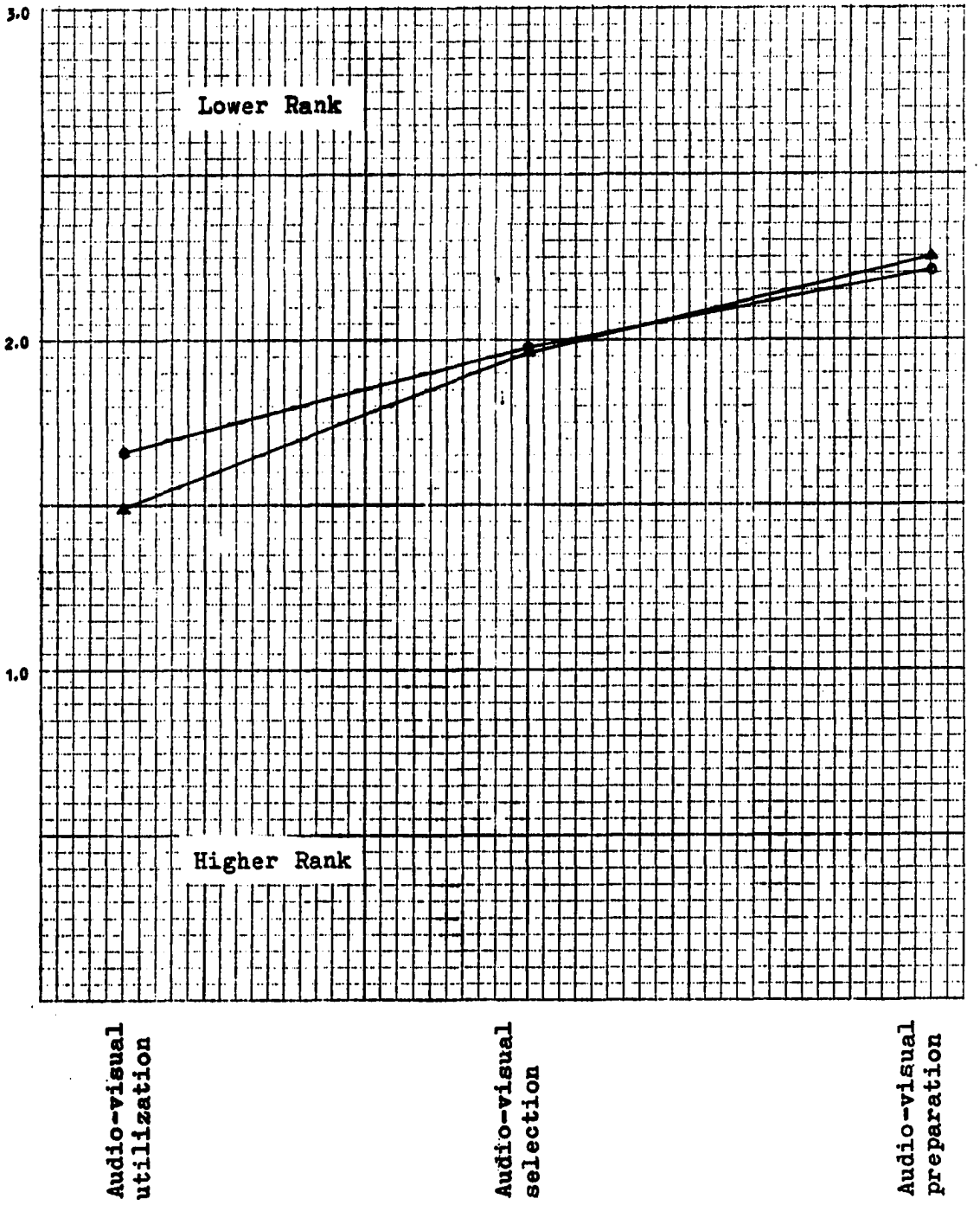
| Course | Ranking Index for all Teachers Responding | Rank According to Index | Ranking Index Course Taken | Ranking Index Course Not Taken | Ranking Index 1-6 Years Experience | Ranking Index 7 or More Years Experience | Ranking Index for Teachers with 0-20 Hours of Graduate Science | Ranking Index for Teachers with 21 or More Hours of Graduate Science | Ranking Index for Teachers with 21 or More Graduate Hours in one Science |
|---|---|---|---|---|---|---|---|---|---|
| Group I | | | | | | | | | |
| Audio-visual utilization | 1.66 | 1 | 1.64 | 1.67 | 1.64 | 1.66 | 1.62 | 1.71 | 1.67 |
| Audio-visual selection | 1.98 | 2 | 1.89 | 2.02 | 2.05 | 1.96 | 2.00 | 2.09 | 1.77 |
| Audio-visual preparation | 2.21 | 3 | 1.99 | 2.34 | 2.24 | 2.20 | 2.29 | 1.99 | 2.30 |
| Group II | | | | | | | | | |
| Extra-curricular | 8.11 | 12 | 6.71 | 8.74 | 8.50 | 7.99 | 7.87 | 8.26 | 8.53 |
| Educational research | 6.19 | 7 | 4.95 | 7.37 | 6.00 | 6.24 | 5.94 | 6.43 | 6.47 |
| Psychology | 4.57 | 6 | 4.40 | 5.47 | 5.03 | 4.46 | 4.59 | 4.77 | 4.20 |
| Educational measurements | 3.94 | 3 | 3.68 | 4.81 | 4.21 | 3.87 | 3.91 | 3.82 | 4.21 |
| Statistics | 6.96 | 10 | 5.94 | 7.60 | 6.82 | 7.01 | 6.96 | 6.80 | 7.24 |
| Guidance | 4.12 | 4 | 3.87 | 4.68 | 4.54 | 4.03 | 3.77 | 4.89 | 3.90 |
| Philosophy of education | 6.79 | 8 | 6.17 | 8.16 | 7.94 | 6.52 | 6.75 | 6.85 | 6.80 |
| History of education | 7.95 | 11 | 7.34 | 9.05 | 9.46 | 7.58 | 7.86 | 8.43 | 7.39 |
| Curriculum | 4.41 | 5 | 4.01 | 5.09 | 4.67 | 4.34 | 4.91 | 4.11 | 3.59 |
| Problems of teaching | 3.43 | 1 | 3.19 | 3.82 | 4.07 | 3.26 | 3.35 | 3.38 | 3.71 |
| Methods of instruction | 3.58 | 2 | 3.41 | 3.90 | 4.17 | 3.42 | 3.66 | 3.58 | 3.44 |

TABLE 13.--Continued

| Course | Ranking Index for all Teachers Responding | Rank According to Index | Ranking Index Course Taken | Ranking Index Course Not Taken | Ranking Index 1-6 Years Experience | Ranking Index 7 or More Years Experience | Ranking Index for Teachers with 0-20 Hours of Graduate Science | Ranking Index for Teachers with 21 or More Hours of Graduate Science | Ranking Index for Teachers with 21 or More Graduate Hours in one Science |
|---|---|---|---|---|---|---|---|---|---|
| Principles of administration | 6.83 | 9 | 5.82 | 8.00 | 7.05 | 6.77 | 6.76 | 6.88 | 6.91 |
| Group III | | | | | | | | | |
| Modern advances in science | 1.75 | 1 | 1.50 | 2.03 | 2.05 | 1.68 | 1.81 | 1.60 | 1.85 |
| Science teaching methods | 2.76 | 3 | 2.49 | 2.90 | 2.84 | 2.74 | 2.69 | 2.78 | 2.94 |
| Laboratory techniques and preparation | 2.22 | 2 | 1.90 | 2.38 | 2.40 | 2.15 | 2.24 | 2.29 | 2.01 |
| Research in science | 3.79 | 4 | 3.34 | 4.02 | 3.63 | 3.83 | 3.89 | 3.89 | 3.45 |
| History of science area | 4.52 | 5 | 3.55 | 4.77 | 4.84 | 4.43 | 4.52 | 4.67 | 4.32 |
| History and/or philosophy of science | 5.15 | 6 | 4.43 | 5.44 | 5.62 | 5.03 | 5.33 | 5.19 | 4.66 |
| Calculus | 5.36 | 7 | 4.44 | 5.79 | 5.15 | 5.42 | 5.53 | 4.84 | 5.79 |
| Mathematics above calculus | 6.80 | 8 | 5.85 | 6.99 | 6.81 | 6.80 | 7.00 | 6.75 | 7.19 |

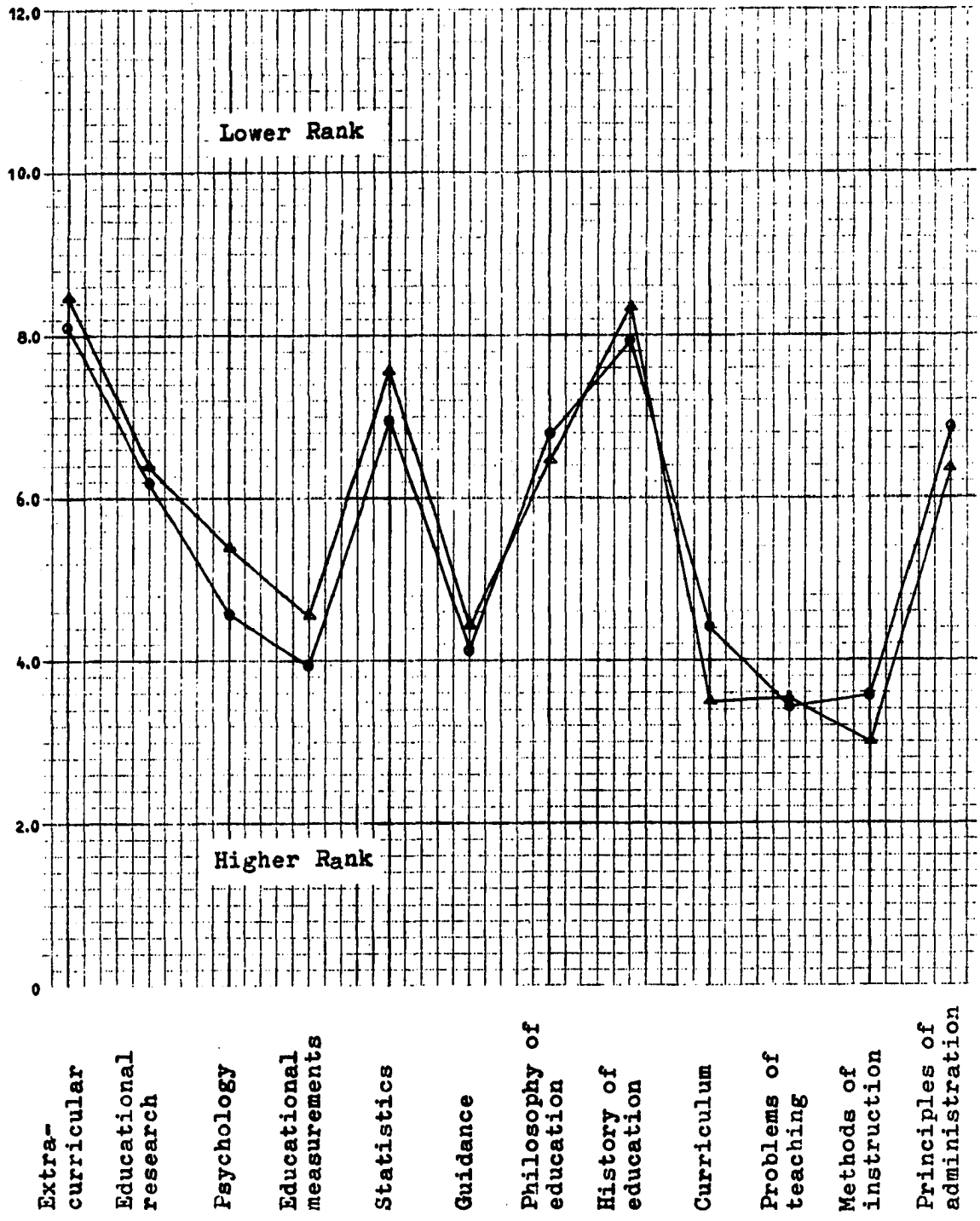
TABLE 14.--Rankings of Courses for the Fifth Year by Administrators with Ranking Indices

| Course | Ranking Index | Rank According to Index |
|---|---|---|
| Group I | | |
| Audio-visual utilization | 1.49 | 1 |
| Audio-visual selection | 1.97 | 2 |
| Audio-visual preparation | 2.25 | 3 |
| Group II | | |
| Extra-curricular | 8.43 | 12 |
| Educational research | 6.39 | 8 |
| Psychology | 5.39 | 6 |
| Educational measurements | 4.54 | 5 |
| Statistics | 7.53 | 10 |
| Guidance | 4.42 | 4 |
| Philosophy of education | 6.45 | 9 |
| History of education | 8.35 | 11 |
| Curriculum | 3.50 | 2 |
| Problems of teaching | 3.53 | 3 |
| Methods of instruction | 3.00 | 1 |
| Principles of administration | 6.36 | 7 |
| Group III | | |
| Modern advances in science | 2.12 | 1 |
| Science teaching methods | 2.32 | 3 |
| Laboratory techniques and preparation | 2.27 | 2 |
| Research in science | 3.65 | 4 |
| History of science area | 4.67 | 5 |
| History &/or philosophy of science | 5.05 | 6 |
| Calculus | 5.65 | 7 |
| Mathematics above calculus | 6.96 | 8 |



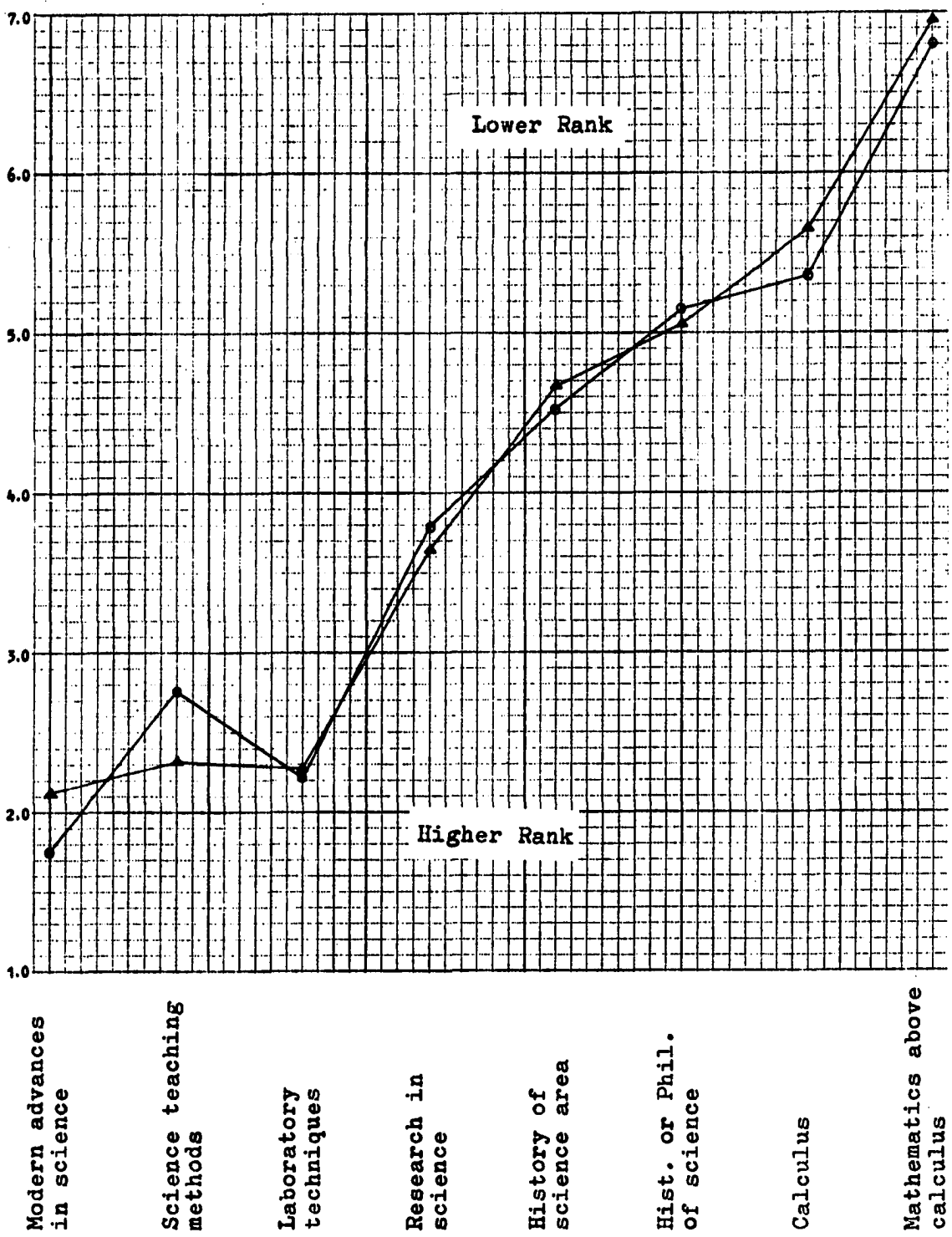

Graph 6.--Ranking indices for courses in Group I.

o—— Ranking by teachers.
Δ—— Ranking by administrators.




Graph 7.--Ranking indices for courses in Group II.

o——— Ranking by teachers.
Δ——— Ranking by administrators.




Graph 8.--Ranking indices for courses in Group III.

o—— Ranking by teachers.
Δ—— Ranking by administrators.

tended to favor the course slightly more than did other categories of teachers.

Audio-visual selection was ranked second by both teachers (index 1.98) and administrators (index 1.97). Teachers who had taken the course tended to rank it higher than those who had not taken it, teachers with more than 6 years experience tended to rank the course higher than those with less, and teachers with 21 or more hours of graduate science in a single area tended to rank the course higher than did other categories of teachers.

Audio-visual preparation was ranked third by both teachers (index 2.21) and administrators (index 2.25). Teachers who had taken the course and those with 21 or more total hours of graduate science responded a little more favorably to the course.

Group II

Extra-curricular activities was ranked twelfth by teachers and by administrators--indices 8.11 and 8.43. Teachers who had taken the course were a little more favorable to it than teachers who had not taken it, teachers with more than 6 years experience tended to rank the course higher than those with less experience, and teachers with less than 21 hours of graduate science tended to rank the course higher than did those teachers with more science.

Educational research was ranked seventh by teachers (index 6.19) and eighth by administrators (index 6.39). Teachers who had taken the course favored it more than did those who had not taken it. Indices for teachers having 6 or less years experience and those having 20 or less

hours of graduate science indicated the responses of those groups to be more favorable to the course.

Educational psychology was ranked sixth by both teachers and administrators. Teachers (index 4.57) tended to rank the course higher than administrators (index 5.39) based on the ranking indices. Teachers who had taken the course, those with more than 6 years experience, and those having more than 20 hours of graduate science in a single area showed indices more favorable to the course.

Educational Measurements and Evaluation was ranked third by teachers (index 3.94) and fifth by administrators (index 4.54). Teachers who had taken the course and those having had 7 or more years experience tended to rank the course higher than those who had not taken the course and those with less experience. Teachers with 21 or more hours of graduate science in a single area responded less favorably to the course than did related categories of teachers.

Educational statistics was ranked tenth by teachers and by administrators--indices 6.96 and 7.53. The index for teachers who had taken the course indicated a more favorable response than was shown by those who had not taken it. Indices for teachers with less than 7 years experience and for teachers with more than 21 total hours of graduate science indicated more favorable response to the course by those categories of teachers.

Guidance was ranked fourth by teachers (index 4.12) and by administrators (index 4.42). Teachers who had taken the course tended to rank it higher. Teachers having had less than 7 years experience and teachers having had more than 21 total hours of graduate science were

less favorable to the course.

Philosophy of education was ranked eight by teachers (index 6.79) and ninth by administrators (index 6.45). Indices for teachers who had taken the course and for those with 7 or more years experience indicated a tendency by those groups to rank the course higher.

History of education was ranked eleventh by teachers (index 7.95) and by administrators (index 8.35). Teachers who had taken the course and those having more than 6 years experience tended to rank the course higher. Those teachers having more than 21 total hours of graduate science responded least favorably to the course in those categories of teachers.

Course and curriculum development was ranked fifth by teachers (index 4.41) and second by administrators (index 3.50). Teachers who had taken the course, those with 7 or more years experience, and those with 21 or more hours of graduate science in a single area responded most favorably in those categories to the course.

Problems of teaching was ranked first by teachers (index 3.43) and third by administrators (index 3.53). Teachers who had taken the course and those with 7 or more years experience tended to rank the course higher. Teachers with 21 or more hours of graduate science in a single area responded less favorably than teachers with 21 or more total hours of graduate science or those with less than 21 hours of graduate science.

Materials and methods of instruction was ranked second by teachers (index 3.58) and first by administrators (index 3.00). Teachers who had taken the course tended to rank it higher than teachers who had not

taken it. Teachers having 7 or more years experience and those with more than 20 hours of graduate science in a single area tended to rank the course higher in their respective categories.

Principles of school administration was ranked ninth by science teachers (index 6.83) and seventh by administrators (index 6.36). Teachers who had taken the course tended to rank it higher. Teachers with more than 6 years experience and those with less than 21 hours of graduate science also tended to rank the course higher than did other teachers.

Group III

Modern advances in science was ranked first in group III by both teachers and administrators--indices 1.75 and 2.12. The indices indicate that teachers tended to rank this course higher than did administrators. Teachers who had taken the course, those having more than 6 years experience, and those with more than 21 total hours of graduate science tended to rank the course higher.

Advanced science teaching methods was ranked third by both teachers and administrators--indices 2.76 and 2.32. Teachers who had taken the course tended to rank it higher than did those who had not taken it. Teachers having more than 20 hours of graduate science in a single area were less favorable to the course.

Laboratory techniques and preparation of laboratory materials was ranked second by teachers (index 2.22) and by administrators (index 2.27). Teachers who had taken this course, those having had more than 6 years experience, and those having more than 20 hours of graduate science in a single area tended to rank the course higher than did others in their

respective categories.

Research in a science area was ranked fourth by both teachers and administrators--indices 3.79 and 3.65. Teachers who indicated experience with research, those with six or fewer years of experience, and those with 21 or more hours of graduate science in a single area tended to rank research higher than did others in those categories.

History of your major science area was ranked fifth by teachers (index 4.52) and by administrators (index 4.67). Teachers who had taken the course, those with 7 or more years experience, and those with more than 20 hours of graduate science in a single area favored the course to a greater extent than other categories of teachers.

History and/or philosophy of science was ranked sixth by both teachers and administrators--indices 5.15 and 5.05. Teachers who had taken the course, those with more than 6 years experience, and those with more than 20 hours of graduate science in a single area tended to rank the subject higher.

Calculus was ranked seventh by both teachers and administrators--indices 5.36 and 5.65. Teachers who had taken the course, those with less than 7 years experience, and those with 21 or more total hours of graduate science showed a tendency to rank the course higher.

Mathematics above calculus was ranked last by teachers and by administrators--indices 6.80 and 6.96. Teachers who had taken the work and those with 21 or more total hours of graduate science tended to rank this course higher.

Agreement between high school science teachers and school administrators in the overall ranking of courses in the above three groups was

remarkably good. In the case of only one course was the difference in rank order indicated by the two groups of respondents as much as three places different. Teachers ranked curriculum development fifth in group II and administrators ranked it second. Teachers who had taken a course consistently showed a lower ranking index than those teachers who had not taken the course, showing in this way a tendency to rank the course higher.

## Group IV

High school science teachers responding to group IV were asked to list courses offered during the fifth year of teacher education, in their major and related science areas, that they considered to be most valuable to the secondary school science teacher. Administrators were asked to suggest courses most valuable to teachers in specific areas they teach. The teaching areas and combinations listed in the questionnaire, for which administrators were to suggest courses, were biology, chemistry, physics, junior high school science, chemistry and biology, and chemistry and physics.

Because of the open ended nature of group IV the courses listed were quite varied. Due to this fact, only the more frequently suggested courses were tabulated in the areas: biology, chemistry, physics, and related areas. Very general courses such as biology, botany, chemistry, and so on were not extracted from the data unless specifically designated for advanced credit. The ten most frequent course suggestions by teachers in each specified subject area are shown by rank in Table 15. The ten most frequent course suggestions by administrators in each specified

TABLE 15.--Most Frequent Course Suggestions in Science Areas by Teachers

| Rank | Subject Areas and Courses | | | |
|---|---|---|---|---|
| | Biology | Chemistry | Physics | Related Areas |
| 1. | Human Physiology | Organic Chemistry | Electronics | Geology and Earth Science |
| 2. | Genetics | Biochemistry | PSSC Physics | Mathematics |
| 3. | Microbiology | Advanced Inorganic Chemistry | Nuclear Physics | Laboratory Methods and Techniques |
| 4. | Ecology | Physical Chemistry | Mechanics | Astronomy |
| 5. | Comparative Anatomy | Analytical Chemistry | Modern Physics | Methods and Materials |
| 6. | Entomology | Advanced Organic Chemistry | Electricity | History and Philosophy of Science |
| 7. | Taxonomy | CHEM Study and CBA Chemistry | Heat | Psychology |
| 8. | BSCS Biology | Modern Chemistry | Atomic Physics | Research |
| 9. | Plant Physiology | History of Chemistry | Optics | Meteorology |
| 10. | Cytology | Radiochemistry | AC and DC Circuits | Geography |

teaching area or combination of areas are shown by rank in Table 16. Suggestions for the junior high school science teacher were so general they were not tabulated.

An examination of Tables 15 and 16 will show many of the courses listed by administrators in the specified teaching areas to be those courses listed by teachers in subject areas. Genetics, human physiology,

TABLE 16.--Most Frequent Course Suggestions in Teaching Areas by Administrators

| Rank | Teaching Areas and Courses | | | | |
|---|---|---|---|---|---|
| | Biology | Chemistry | Physics | Chemistry and Biology | Chemistry and Physics |
| 1. | Genetics | Organic Chemistry | Modern Physics | Biochemistry | Biochemistry |
| 2. | Human Physiology | Biochemistry | Atomic Physics | Organic Chemistry | Organic Chemistry |
| 3. | Microbiology | Laboratory Techniques | PSSC Physics | Advanced Inorganic Chemistry | Advanced Inorganic Chemistry |
| 4. | Comparative Anatomy | Advanced Inorganic Chemistry | Nuclear Physics | Genetics | CHEM Study Chemistry |
| 5. | Conservation | Analytical Chemistry | Electronics | Human Physiology | Modern Advances in Chemistry and Physics |
| 6. | Entomology | Modern Advances in Chemistry | Radiation Physics | Comparative Anatomy | Modern Physics |
| 7. | Modern Concepts of Biology | Physical Chemistry | Optics | Radiation Biology | Nuclear Physics |
| 8. | Systematic Botany | Instrumental Methods | Mechanics | Advanced Zoology | Mechanics |
| 9. | Invertebrate Zoology | Chemistry of Water and Sewage | Advanced Electricity | Advanced Botany | Radiation Physics |
| 10. | Ecology | Radiochemistry | Sound | Taxonomy | PSSC Physics |

microbiology, comparative anatomy, entomology, and ecology were listed among the ten most valuable biology courses by both teachers and administrators. Teachers listed BSCS biology eighth. Both teachers and administrators listed organic chemistry, biochemistry, advanced inorganic chemistry, analytical chemistry, physical chemistry, and radiochemistry among the top ten. Teachers listed CHEM Study and CBA chemistry seventh. Physics courses listed among the ten most valuable by both teachers and administrators were: electronics, PSSC physics, nuclear physics, mechanics, modern physics, electricity, atomic physics, and optics.

## Analysis of Responses of Science Teachers and Administrators to Part Four

The high school science teachers and administrators were asked to rank the four groups of courses, from Part Three of the questionnaire, which might be included in the fifth year of education for the secondary school science teacher. Group I consisted of a group of three courses dealing with the utilization, selection, and preparation of audio-visual materials; group II consisted of professional education courses; group III consisted of courses related to the science teaching field; and group IV consisted of science courses.

Ranking of the groups of courses was made on the basis of ranking indices obtained by the same method as was used in previous parts of the questionnaire. The group showing the ranking index nearest 1.00 was given the rank of one, the group with the index next nearest 1.00 was given the rank of two, and so on for the four groups. The group with the largest ranking index (the index nearest 4.00) was given the rank of four, the lowest rank. Those data are presented in table 17. Ranking indices

TABLE 17.--Rankings of Groups of Courses

| | Science Teachers | | | | | | | Administrators | |
|---|---|---|---|---|---|---|---|---|---|
| | Ranking Index 1-6 Years Experience | Ranking Index 7 or More Years Experience | Ranking Index for Teachers with 0-20 Hours of Graduate Science | Ranking Index for Teachers with 21 or More Hours of Graduate Science | Ranking Index for Teachers with 21 or More Graduate Hours in One Science | Ranking Index for all Teachers Responding | Rank According to Index | Ranking Index for Administrators | Rank According to Index |
| Group I | | | | | | | | | |
| Audio-visual materials | 3.39 | 3.12 | 3.13 | 3.05 | 3.44 | 3.17 | 4 | 2.63 | 4 |
| Group II | | | | | | | | | |
| Professional education | 3.16 | 2.87 | 2.72 | 3.18 | 3.04 | 2.92 | 3 | 2.58 | 3 |
| Group III | | | | | | | | | |
| Courses related to science areas | 1.93 | 1.91 | 1.93 | 1.79 | 2.04 | 1.91 | 2 | 1.98 | 1 |
| Group IV | | | | | | | | | |
| Science courses | 1.40 | 1.85 | 1.96 | 1.68 | 1.42 | 1.76 | 1 | 2.41 | 2 |

are shown for responses of science teachers in the following categories: one to six years teaching experience, seven or more years experience, zero to twenty semester hours of graduate science, twenty-one or more total semester hours of graduate science, and twenty-one or more semester hours of graduate science in a single area. There are also shown overall ranking indices for all teachers responding, the rank of each group based on those indices, the ranking indices for administrators responding, and the rank of the courses based on the ranking indices of the administrators.

Those data presented in Table 17 show that group IV, courses in science areas, was ranked first by science teachers. Those teachers with 6 or fewer years of teaching experience and those having 21 or more hours of graduate science in a single area tended to rank this group higher, showing indices of 1.40 and 1.42. Administrators ranked group IV second, showing an index of 2.41. Group III, courses related to science areas, was ranked second by science teachers (index 1.91). Science teachers having 21 or more total semester hours of graduate science tended to rank this group higher than did other categories of teachers. Administrators ranked group III first, showing a ranking index of 1.98. While administrators ranked the group first, the ranking index of 1.98 was very near the index of 1.91 shown by science teachers. Group II was ranked third by both teachers and administrators--indices 2.92 and 2.58. Administrators tended to rank this group of courses higher than did science teachers. Teachers having less than 21 hours of graduate science tended to rank group II higher than did teachers with more science and teachers with 7 or more years experience tended to rank group II courses

higher than did teachers with less experience. Group I courses were ranked fourth by both science teachers and administrators, showing indices of 3.17 and 2.63. Teachers with less than 7 years experience and those with 21 or more hours of graduate science in a single area tended to rank group I lower than did other categories of teachers. The range of ranking indices calculated from rankings of the groups by administrators was not as great as that observed for teachers.

Respondents were invited to write comments concerning the fifth year of science teacher education after completing the questionnaire. The most frequently expressed opinion was that the fifth year of education for the science teacher should be devoted primarily to science subject matter courses--to increasing depth in the teaching field and increasing breadth in other science areas. The need was expressed for methods and techniques for improving instruction directed to the problems of the high school science teacher. There were also comments relative to the desirability of college teachers of the high school teachers having had high school teaching experience.

## Summary

An analysis of data presented in Tables four through eight indicated that high school science teachers of Oklahoma high schools who hold a master's degree and administrators of Oklahoma high schools held specific opinions concerning certain aspects of the first year of graduate education for high school science teachers. The data showed further that on most of the specified statements relative to the fifth year of science teacher education a consensus could be obtained.

Tables four through eight deal with items one through twenty-nine

of Part Two of the questionnaire. Those data show that secondary school science teachers and school administrators expressed conclusive disagreement with only one statement. They disagreed with the statement that, "The fifth year should be considered a fifth year of teacher education without awarding a master's degree." They expressed conclusive agreement with twenty-three of the twenty-nine statements. The data show they expressed inconclusive agreement with the statement that the completion of calculus should be required for a physical science major. Statement five, that a thesis should be required, received an inconclusive response from teachers (index 3.00) and inconclusive agreement from administrators (index 2.79). A ranking index of 2.34 by teachers was taken as conclusive agreement with statement six concerning formal science courses while the index for administrators indicated inconclusive agreement with the statement. Teachers were in inconclusive agreement with statement twenty concerning a terminal program while administrators indicated conclusive agreement with it. The data show also that, with one exception, teachers who indicated experience with an item tended to agree with it more than did teachers not indicating experience. No such trend was observed in responses of administrators. Other categories of science teachers, those based on years of teaching experience and those based on hours of graduate science, exhibited no pattern of response.

Data in Tables nine and ten show science teachers and administrators thought science courses should receive major emphasis in the fifth year of science education for the high school science teacher. Teachers indicated 61.45 per cent (46.34 per cent in the major area) of the program

should be devoted to science while administrators designated 52.40 per cent (41.53 per cent in the major area). Teachers who taught only one subject indicated 63.14 per cent (49.49 per cent in the major area) of the program should be devoted to science courses. Teachers proposed that 21.95 per cent be devoted to the areas of professional education (8.62 per cent), science education (8.65 per cent), and observation and advanced student teaching (4.68 per cent). Administrators suggested 28.18 per cent of the program be devoted to those education areas. Teachers designated 6.32 per cent of the program to be research while administrators indicated 8.39 per cent. Unrestricted electives were allowed 9.08 per cent of the program by teachers and 10.19 per cent by administrators. Approximately 69 per cent of the teachers responding to item thirty-one thought a science subject major should be required. They indicated that 48.32 per cent of the program should be devoted to that major. Of the administrators responding, about 61 per cent thought a science subject major should be required but they specified only 30.94 per cent of the program to that major. A greater percentage (about 83 per cent) of the teachers teaching only one subject thought a science subject major should be required and they would devote 54.37 per cent of the program to the major.

Data in Tables eleven and twelve show that more than half (54.92 per cent) of the science teachers and 37.97 per cent of the administrators thought the science departments should offer the methods courses while 50.63 per cent of the administrators and 36.36 per cent of the science teachers thought either science or education departments might teach it. Almost two-thirds (65.79 per cent) of the teachers and 79.75 per cent of

the administrators indicated the teacher of the methods course should have a background in both science and education. Two (0.75 per cent) of the teachers and only 5.06 per cent of the administrators suggested a teacher with a predominately professional education background. Over two-thirds (67.52 per cent) of the science teachers but only 35.71 per cent of the administrators felt a need for program changes in science, at the college level, to better prepare teachers for "new" high school science programs. About half (49.23 per cent) of the teachers and 12.50 per cent of the administrators indicated they had had instruction in any "new" programs.

Data concerning courses for the fifth year of science teacher education, presented in Tables thirteen and fourteen, show good agreement between teachers and administrators on course rankings. Utilization of Audio-Visual Materials was given highest ranking among courses in group I. Teachers and administrators agreed on the ranking of five of the twelve courses in group II and agreed within one rank on three others. Teachers ranked Problems of Teaching first and Materials and Methods of Instruction second while administrators ranked those third and first. Both gave Statistics, History of Education, and Extra-curricular Activities ranks of ten, eleven and twelve. Teachers and administrators were in agreement on the ranking of courses in group III, with modern advances in science ranked first, laboratory techniques and preparation of laboratory materials ranked second, and advanced science teaching methods third. The data show that teachers who had taken a course tended to rank it higher than did teachers who had not taken it. No such pattern of responses was observed among categories of teachers based on experience and on semester hours of graduate science.

Science courses listed in group IV were varied but a few courses in each area appeared more frequently than others. Teachers and administrators were in general agreement on the science courses in each area that would be most valuable to the high school science teacher.

Science teachers ranked group IV, science courses, first, and group III, courses related to science areas, second, among the four groups. Administrators reversed the order of these two groups in their ranking. Teachers with less experience and those with more graduate science in a single area tended to rank group IV higher. Group II, professional education, and group I, audio-visual materials, were ranked third and fourth. The most frequently expressed comment was that most of the fifth year of education for the secondary school science teacher should be devoted to science subject areas increasing depth and breadth in science. Teachers' comments relative to the importance of considering the general area of science education demonstrates the need for institutions of higher education to provide experience in that area.

# CHAPTER IV

## SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The study was concerned with opinions pertaining to the fifth-year-graduate program of teacher education for secondary school science teachers. Opinions were obtained from science teachers in the secondary schools of Oklahoma who had completed a master's degree program and from administrators of high schools of Oklahoma. The specific purposes of the research were: (1) to obtain opinions concerning the first year of graduate education from science teachers in the secondary schools of Oklahoma who hold master's degrees, (2) to obtain opinions about the same items from administrators who are responsible for selecting competent teachers, and (3) to interpret the findings of this study with regard to guidelines and suggestions relative to a desirable fifth year of graduate education for secondary school science teachers.

The following procedures were used in the study: (1) Questionnaires were prepared to be used with high school science teachers and school administrators. (2) The questionnaires were used in a preliminary study with a sample of teachers and superintendents to determine their effectiveness in obtaining the desired information. (3) A list of science teachers of Oklahoma high schools who had completed a master's degree program was obtained, as was a stratified random sample of

administrators. (4) A total of 324 secondary school science teachers holding a master's degree and 114 administrators, selected from Oklahoma high schools, were sent questionnaires. A total of 267 usable questionnaires was received from science teachers and eighty from administrators. These figures represent a return of 82.41 per cent from science teachers and 70.18 per cent from administrators. (5) The responses were tabulated and analyzed to obtain a basis for recommendations relative to the graduate education of secondary school science teachers. The first twenty-nine statements of Part Two were answered from two frames of reference--first on the basis of the respondent's experience with the item in his graduate education and secondly on the basis of his recommendations for a graduate program. The responses to each item of the questionnaires were averaged to obtain a mean response (ranking indices or percentages where applicable) for the item. Statements and courses were ranked on the basis of ranking indices and responses to all items were studied. (6) Responses of teachers and administrators were compared and contrasted. (7) Rankings were made on the basis of overall responses. Responses were also analyzed on the basis of experience with the item, years of teaching experience, semester hours of graduate science completed, and number of different courses taught.

## Findings

A rank-order presentation of the first twenty-nine statements from Part Two of the questionnaires follows. The rank for each statement was based on the ranking indices calculated from responses of all science teachers responding to the items. Following each statement are the rank

and ranking index given the item by administrators. The first group of statements was given a ranking index of less than 2.50 based on the responses of science teachers. The response by teachers to each statement in this group was interpreted to indicate conclusive agreement with the statement as a recommended part of the graduate education of a high school science teacher.

Rank 1. (Index 1.23) Statement 10. Provide adequate laboratory facilities so that teachers may have experience working with audio-visual, curriculum, and laboratory materials related to their particular science area. (Administrators--Rank 1--Index 1.23).

Rank 2. (Index 1.36) Statement 24. Provide advanced courses in science areas designed especially for secondary teachers. (Administrators--Rank 3--Index 1.47).

Rank 3. (Index 1.41) Statement 14. Use instructional methods in college classes which emphasize demonstrations, class participation, and use of audio-visual materials. (Administrators--Rank 2--Index 1.35).

Rank 4. (Index 1.68) Statement 11. Provide the use of laboratory schools (public or college connected) for demonstration, research, and experimentation. (Administrators--Rank 5 tie - Index 1.62).

Rank 5. (Index 1.69) Statement 28. Require the completion (undergraduate or postgraduate) of a minimum of 10 semester hours in each of the following (regardless of the major science area): biology, chemistry, and physics. (Administrators--Rank 11--Index 1.87).

Rank 6. (Index 1.72) Statement 25. Provide introductory courses in science which are related to his major area and which offer graduate credit, without prerequisites, and are prepared especially for

secondary teachers. (Administrators--Rank 12 tie--Index 1.91).

Rank 7. (Index 1.77) Statement 18. Include at least one science course taught by the inquiry or discovery approach. (Administrators--Rank 12 tie--Index 1.91).

Rank 8 (tie). (Index 1.82) Statement 2. Provide in-service courses for individual or group study of local science education problems for which credit is received. (Administrators--Rank 7--Index 1.76).

Rank 8 (tie). (Index 1.82) Statement 16. Students should be encouraged to have at least one year of full-time teaching experience before entering the fifth-year program. (Administrators--Rank 4--Index 1.60).

Rank 10. (Index 1.83) Statement 4. Provide workshops that combine the scientific disciplines for a better understanding of their interdependence. (Administrators--Rank 10--Index 1.84).

Rank 11. (Index 1.86) Statement 19. Encourage research in a science area for credit on an elective basis. (Administrators--Rank 14 tie--Index 1.99).

Rank 12. (Index 1.89) Statement 15. Provide for research in science education to be taken for credit on an elective basis. (Administrators--Rank 16--Index 2.01).

Rank 13. (Index 1.98) Statement 22. Include a course in history and/or philosophy of science. (Administrators--Rank 17--Index 2.03).

Rank 14. (Index 2.04) Statement 29. Include programs designed outside the regular class structure patterned after NSF institute type programs but not necessarily nationally sponsored with participant stipends. (Administrators--Rank 19--Index 2.23).

Rank 15 (tie). (Index 2.05) Statement 7. Emphasize scientific research from the point of view of preparing teachers to become intelligent consumers of such research. (Administrators--Rank 18--Index 2.14).

Rank 15 (tie). (Index 2.05) Statement 12. A flexible program with few specific course requirements in either science or education so that a teacher may elect those courses which best meet his needs. (Administrators--Rank 22--Index 2.36).

Rank 17. (Index 2.06) Statement 21. So design the program that its completion will enable a person to pursue the doctorate in science education. (Administrators--Rank 20--Index 2.26).

Rank 18. (Index 2.24) Statement 26. The completion of the fifth year should have as a prerequisite the completion of mathematics through algebra, trigonometry, and analytical geometry either as an undergraduate or postgraduate. (Administrators--Rank 25--Index 2.49).

Rank 19. (Index 2.27) Statement 1. Provide teachers of high school science an opportunity to improve their cultural backgrounds by taking some work in cultural fields outside the science and professional education fields. (Administrators--Rank 5 tie--Index 1.62).

Rank 20. (Index 2.31) Statement 8. Emphasize educational research from the point of view of preparing teachers to become intelligent consumers of such research. (Administrators--Rank 14 tie--Index 1.99).

Rank 21. (Index 2.33) Statement 17. Students should be required to have at least one year of full-time teaching experience before entering the fifth-year program. (Administrators--Rank 9--Index 1.83).

Rank 22. (Index 2.34) Statement 6. Provide formal science

courses which place emphasis on theoretical knowledge and technical skills without reference to classroom teaching. (Administrators--Rank 28--Index 2.97).

Rank 23. (Index 2.42) Statement 3. Provide a general course in school administration for a better understanding of the job of the school superintendent and principal. (Administrators--Rank 8--Index 1.80).

Rank 24. (Index 2.48) Statement 9. Provide opportunities for the teacher to apply and extend his professional competence through directed practice teaching at the graduate level. (Administrators--Rank 21--Index 2.32).

The following statements were given ranking indices of from 2.50 to 3.00 based on responses of science teachers. Response to each statement in this group was interpreted as inconclusive agreement with the statement by teachers.

Rank 25. (Index 2.80) Statement 27. The completion of the fifth year should have as a prerequisite the completion of mathematics through two semesters of calculus either as undergraduate or post-graduate work for the physical science major. (Administrators--Rank 26--Index 2.77).

Rank 26. (Index 2.81) Statement 20. The fifth year should be a terminal program independent of providing prerequisites for doctoral study. (Administrators--Rank 24--Index 2.43).

Rank 27. (Index 2.86) Statement 13. Require that the graduate student conduct a research project in science education. (Administrators--Rank 23--Index 2.37).

The following statement was given a ranking index of 3.00 by teachers which indicates no tendency to either agree or disagree with the statement and was interpreted as inconclusive.

Rank 28. (Index 3.00) Statement 5. Require the completion of a thesis for the master's degree. (Administrators--Rank 27--Index 2.79).

The following statement was the only one given a ranking index greater than 3.50 based on responses of either science teachers or administrators. The response to this statement was interpreted to indicate conclusive disagreement with the statement as a recommendation for the fifth-year program for high school science teachers.

Rank 29. (Index 4.01) Statement 23. The fifth year should be considered a fifth year of teacher education without awarding a master's degree. (Administrators--Rank 29--Index 3.62).

Science teachers and administrators were asked to indicate the percentage of the total fifth-year program that should be devoted to specified areas. The responses of teachers were analyzed on the basis of number of different courses taught and the overall percentages indicated. The overall percentages indicated by teachers and by administrators were: (1) professional education courses, 8.62 per cent and 14.07 per cent; (2) science in major science area, 46.34 per cent and 41.53 per cent; (3) other science courses, 15.11 per cent and 10.87 per cent; (4) science education courses, 8.65 per cent and 8.47 per cent; (5) research, 6.32 per cent and 8.39 per cent; (6) observation and advanced student teaching, 4.68 per cent and 5.64 per cent; (7) unrestricted electives, 9.08 per cent and 10.19 per cent; and (8) other required work (mainly mathematics was specified), 1.19 per cent and 0.82

per cent.

When asked should a science speciality such as chemistry, physics, or biology be required; 69 per cent of the teachers and 61 per cent of the administrators checked, yes. Those teachers indicated 48.32 per cent of the program should be devoted to a science subject major and the administrators indicated 30.94 per cent. Almost 83 per cent of the teachers who taught only one science area thought a subject major should be required, and that 54.37 per cent of the program should be devoted to the major.

When asked which department should teach advanced methods courses in science teaching, the teachers (overall) and administrators responded as follows: (1) education department, 4.17 per cent and 10.13 per cent; (2) a science department, 54.92 per cent and 37.97 per cent; (3) either science or education department, 36.36 per cent and 50.63 per cent, and (4) other, 4.55 per cent and 1.27 per cent. Responses of teachers were also analyzed on the basis of teaching experience--as were their responses to the next two topics.

In response to the type of background that would best suit a person to teach the advanced methods course, teachers and administrators responded as follows: (1) predominately professional education, 0.75 per cent and 5.06 per cent; (2) predominately science, 30.08 per cent and 12.66 per cent; (3) combination of science and education, 65.79 per cent and 79.75 per cent; and (4) other (high school teaching experience), 3.38 per cent and 2.53 per cent.

Almost 68 per cent of the teachers and 35.71 per cent of the administrators responding to the question felt a need for program changes

in science, at the college level, to better insure that the high school teacher of science could better teach new science programs. Almost half (49.23 per cent) the teachers and 12.50 per cent of the administrators had had instruction in one of the new programs. Suggestions were made that new teaching techniques be used in college science classes and that courses be developed to prepare high school science teachers for the new science programs.

Part Three of the questionnaires consisted of four groups of courses which might be included in the fifth year of education for the secondary school science teacher. Respondents were asked to rank the courses listed in each of the first three groups and indicate if they had taken a course. In group IV teachers were asked to list courses in their major science area, and in related areas, that they considered most valuable to the secondary school science teacher. Ranking indices were calculated for courses in groups I, II, and III and the overall ranking of courses in a group was made using those indices. The responses of teachers to these groups were analyzed in relation to the number of years of teaching experience, number of semester hours of graduate science completed, and whether or not the course had been taken by the respondent.

Courses are listed in each group in order of rank, based on overall teacher ranking indices. The rank and indices by administrators are shown in parentheses following the course.

Group I. Audio-visual Materials

Rank 1. (Index 1.66) Utilization of Audio-visual Materials (Rank 1--Index 1.49).

Rank 2. (Index 1.98) Selection of Audio-visual Materials (Rank

2--Index 1.97).

Rank 3. (Index 2.21) Making or Preparing Audio-visual Materials (Rank 3--Index 2.25).

Group II. Professional Education

Rank 1. (Index 3.43) Problems of Teaching (Rank 3--Index 3.53).

Rank 2. (Index 3.58) Materials and methods of Instruction (Rank 1--Index 3.00).

Rank 3. (Index 3.94) Educational Measurements and Evaluation (Rank 5--Index 4.54).

Rank 4. (Index 4.12) Guidance (Rank 4--Index 4.42).

Rank 5. (Index 4.41) Course and Curriculum Development (Rank 2--Index 3.50).

Rank 6. (Index 4.57) Educational Psychology (Rank 6--Index 5.39).

Rank 7. (Index 6.19) Educational Research (Rank 8--Index 6.39).

Rank 8. (Index 6.79) Philosophy of Education (Rank 9--Index 6.45).

Rank 9. (Index 6.83) Principles of School Administration (Rank 7--Index 6.36).

Rank 10. (Index 6.96) Educational Statistics (Rank 10--Index 7.53).

Rank 11. (Index 7.95) History of Education (Rank 11--Index 8.35).

Rank 12. (Index 8.11) Extra-curricular Activities (Rank 12--Index 8.43).

Group III. Related Courses

Rank 1. (Index 1.75) Modern Advances in Science (Rank 1--Index 2.12).

Rank 2. (Index 2.22) Laboratory Techniques and Preparation of Laboratory Materials (Rank 2--Index 2.27).

Rank 3. (Index 2.76) Advanced Science Teaching Methods (Rank 3--Index 2.32).

Rank 4. (Index 3.79) Research in a Science Area (Rank 4--Index 3.65).

Rank 5. (Index 4.52) History of Major Science Area (Rank 5--Index 4.67).

Rank 6. (Index 5.15) History and/or Philosophy of Science (Rank 6--Index 5.05).

Rank 7. (Index 5.36) Calculus (Rank 7--Index 5.65).

Rank 8. (Index 6.80) Mathematics above Calculus (Rank 8--Index 6.96).

Group IV. Science Courses

Courses in this group are listed under biology, chemistry, physics, and related areas. Courses listed by administrators in science teaching fields were generally included by teachers under subject headings. The ten most frequently suggested courses in each of the four areas are listed. The most frequently listed biology courses were: (1) human physiology, (2) genetics, (3) microbiology, (4) ecology, (5) comparative anatomy, (6) entomology, (7) taxonomy, (8) BSCS biology, (9) plant physiology, and (10) cytology. The most frequently listed chemistry courses were: (1) organic chemistry, (2) biochemistry, (3) advanced

inorganic chemistry, (4) physical chemistry, (5) analytical chemistry, (6) advanced organic chemistry, (7) CHEM Study and CBA chemistry, (8) modern chemistry, (9) history of chemistry, and (10) radiochemistry. The most frequently listed physics courses were: (1) electronics, (2) PSSC physics, (3) nuclear physics, (4) mechanics, (5) modern physics, (6) electricity, (7) heat, (8) atomic physics, (9) optics, and (10) AC and DC circuits. Other science and related courses were: (1) geology and earth science, (2) mathematics (3) laboratory methods and techniques, (4) astronomy, (5) materials and methods of teaching science, (6) history and philosophy of science, (7) psychology, (8) research, (9) meteorology, and (10) geography.

In the final section of the questionnaire, Part Four, respondents were asked to rank the four previously listed groups of courses. A mean ranking index was determined from responses for each group and the groups were ranked on the basis of the indices. Teacher responses were analyzed on the basis of teaching experience, and amount of graduate science taken. The groups were ranked by teachers as follows:

Rank 1. Group IV Science courses.

Rank 2. Group III Courses related to science areas.

Rank 3. Group II Professional education.

Rank 4. Group I Audio-visual materials.

Administrators ranked Group III first and Group IV second.

## Conclusions

The following conclusions seem to be justified based on data from opinions expressed by science teachers in Oklahoma high schools who have

completed a master's degree program and by administrators of Oklahoma high schools:

1. Graduate work in science should constitute approximately 60 per cent of the fifth-year program for high school science teachers. For teachers teaching a single science area, about 50 per cent of the program should be in that area. The program for teachers teaching more than one science area should provide more breadth in science along with depth in an area.

2. Approximately 24 per cent of the fifth-year program should be devoted to the areas of professional education (approximately 10 per cent) and science education (approximately 14 per cent) including observation and student teaching.

3. Unrestricted electives should make-up about 9 per cent of the program and research about 7 per cent.

4. A science subject major constituting at least 50 per cent of the program would be strongly recommended for teachers who teach a single science.

5. The advanced methods course should be taught by a person with a combination of science and education background and should be offered by a science department or by a science department in cooperation with the education department; credit should be given in either department.

6. Courses should be developed to prepare teachers to teach new science programs in the high school. The laboratory school should be utilized to provide actual classroom experience with the new and experimental programs.

7. Laboratory facilities should be provided so that teachers may

have experience working with audio-visual, curriculum, and laboratory materials related to their particular science area.

8. Advanced courses in science areas, designed especially for secondary school science teachers, should be provided for teachers in the graduate program.

9. Instructional methods which emphasize demonstrations, class participation, and use of audio-visual materials should be used in college classes.

10. Institutions offering a fifth year of teacher education should provide laboratory schools (public or college connected) for demonstration, research, and experimentation. The graduate student should have the opportunity to observe and to put into practice new science programs and teaching techniques.

11. To insure breadth in science as well as depth in one area, the fifth-year program for high school science teachers should require that the candidate will have completed (at the undergraduate or postgraduate level) a minimum of ten semester hours in each of the areas: biology, chemistry, and physics. Only work taken for graduate credit as a part of the fifth-year program would satisfy conclusion one.

12. Each science department should develop an introductory course in its science area that offers graduate credit, without prerequisites, and is designed especially for the secondary school science teacher so that he may take, as a part of his program, science courses related to his major.

13. The program should include at least one science course taught by the inquiry or discovery approach.

14. Provision should be made in the fifth-year program for in-service courses for individual or group study of local science education problems.

15. Students should be strongly encouraged (or required) to have at least one year of full-time teaching experience before entering the fifth-year program.

16. Workshops, designed outside the regular class structure, which combine the scientific disciplines for a better understanding of their interdependence should be provided.

17. Research in a science area and in science education, for credit on an elective basis, should be encouraged.

18. The program should be so designed that upon its completion students who wish, and have so planned their programs, might pursue the doctorate in science education.

19. The program should be flexible with few specific course requirements in either science or education. Some work in cultural fields outside of science and education should be allowed.

20. The completion of the fifth-year program should result in the awarding of a master's degree.

21. Problems of teaching, materials and methods of instruction, educational measurements and evaluation, and guidance, are of more importance among professional education courses listed and history of education and extra-curricular activities are of less importance.

22. Among areas related to science fields, modern advances in the major and related fields, laboratory techniques and preparation of laboratory materials, and advanced science teaching methods are of more value

to the high school science teacher while calculus and mathematics above calculus are of less value.

23. Courses of most value in science areas are: biology--human physiology, genetics, microbiology, ecology, and comparative anatomy; chemistry--organic chemistry, biochemistry, advanced inorganic chemistry, physical chemistry, and analytical chemistry; physics--electronics, PSSC physics, nuclear physics, mechanics, and modern physics; and related courses--geology and earth science, mathematics, laboratory methods and techniques, astronomy, and materials and methods of teaching science.

## Recommendations

Since the foregoing conclusions represent interpretations of the data collected, institutions offering a fifth-year program for science teachers are urged to consider them.

Based upon the data collected during this research, the investigator recommends that the fifth-year program for secondary school science teachers follow the general guidelines set by the following model program.

Model Program

| Discipline | Credit (Semester Hours) | Remarks |
|---|---|---|
| Science | 18-20 | |
| Major Area | 14-16 | The emphasis of the fifth-year program should be on science with some depth in a major area. Teachers teaching more than one science area might benefit more from a broader program with less science in a single area. |

Model Program.--continued

| Discipline | Credit (Semester Hours) | Remarks |
|---|---|---|
| Related Science | 4-6 | Could be used to strengthen a related field and give a broader program. |
| Professional Education | 2-4 | Should be devoted to courses such as problems of teaching, educational measurement and evaluation, and guidance. |
| Science Education | 4-5 | Should be devoted to material and methods of science instruction, laboratory techniques and instruction, and curriculum development including new programs. New programs in laboratory school situations should be included; to include advanced student teaching. |
| Research | 2 | Should be devoted to the type of research experience desired, such as research in science, science education research, or utilization of research. |
| Electives | 3-6 | Might be used to strengthen a science or mathematics area, or if desired, work in a cultural area could be included. |

Recommendations for additional research resulting from this study must be recognized. A similar study of opinions of science teachers outside the state of Oklahoma needs to be done to ascertain what agreement

might be found with the results of this study. A study of the opinions of college and university professors of science and education concerning the results of this study should be conducted to determine the extent of agreement with the recommendations and suggested program. This study revealed a need for science courses designed especially for the graduate science education of the high school science teacher. In view of this finding, a study should be conducted to ascertain the desired structure, content, and presentation of science courses pertinent to the expressed needs of the high school science teacher. Since science education emerges as a recognized area, a study needs to be done to determine guidelines which could be utilized by colleges and universities to establish a dynamic science education program.

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APPENDICES

APPENDIX I

Dear High School Principal:

As a part of a doctoral study, I am seeking the opinions of high school science teachers who hold the master's degree. Please contribute to the study by listing on the attached card the names of your science teachers who hold the master's degree. Return the card to me.

Also, indicate the person primarily responsible for employing high school teachers by responding to that statement on the card.

Sincerely yours,

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

1. School _____
   School address _____
2. Person who selects high school teachers (circle one)
   (a) superintendent (b) principal
   (c) other: (please specify)
3. Names of science teachers with master's degrees:
   a. _____ f. _____
   b. _____ g. _____
   c. _____ h. _____
   d. _____ i. _____
   e. _____ j. _____
4. ( ) Check if you have no high school science teachers with master's degrees.

Thank you.

APPENDIX II

Dear :

Graduate training for teachers is of increasing importance to teachers, teacher education institutions, and state departments of education. Many states already require the completion of a fifth year of education for certification and others are planning such a move. In light of these conditions, the content of this graduate program is of increasing concern to all.

If the fifth year of teacher education is to improve the quality of teaching in our secondary schools, it must meet the needs of the individual teacher. Teaching experience assists people in identifying needs which when met will increase their professional competence. You have been selected as a teacher whose experience places you in a position to render valuable opinions on graduate education needs of high school science teachers.

The opinions obtained from the enclosed questionnaire, which has been prepared under the direction of Dr. John W. Renner, professor of Science Education at the University of Oklahoma, will aid college curriculum planners in revision of the fifth-year program to meet the needs of the teacher.

Your assistance in this important study by responding to the enclosed questionnaire and returning it in the stamped, self-addressed envelope will be appreciated. A prompt return will greatly facilitate the study.

Very truly yours,

G. E. Castleberry
Associate Professor

P. S. Please notify me if you wish a copy of the results of the study.

APPENDIX III

Dear :

As a school administrator, responsible for obtaining appropriately qualified teachers, you know how important graduate educational experiences are. You have been selected as a person whose position and experience as an administrator places you in a position to render valuable opinions on graduate-school needs for high school science teachers.

The opinions obtained from the enclosed questionnaire will aid college curriculum planners in a continued re-evaluation of the fifth-year-graduate program to better meet the needs of the science teacher and, in turn, meet your needs by supplying qualified personnel.

Please assist in this important study, which is being conducted under the direction of Dr. John W. Renner, professor of Science Education at the University of Oklahoma, by responding to the enclosed questionnaire and returning it in the stamped, self-addressed envelope. Your professional cooperation is appreciated. A prompt return will greatly facilitate the study.

Very truly yours,

G. E. Castleberry
Associate Professor

P. S. Please notify me if you wish a copy of the results of the study.

Dear :

As a high school principal in a large city school system, your relationship to the teaching staff is much the same as that of the superintendent in a smaller system. In view of this fact, your assistance in completing the enclosed questionnaire directed to the opinions of superintendents will be appreciated.

Sincerely,

G. E. Castleberry
Associate Professor

APPENDIX IV

PART ONE:

DATA SHEET FOR USE WITH OPINION SURVEY OF SCIENCE TEACHERS CONCERNING THE FIFTH-YEAR-GRADUATE PROGRAM OF TEACHER EDUCATION

1. Sex: (1) ____ Male (2) ____ Female

2. Number of years of teaching experience at close of this year: (Check one)

   (1) ____ Less than one year
   (2) ____ 1 to 3 years
   (3) ____ 4 to 6 years
   (4) ____ 7 to 10 years
   (5) ____ More than 10 years

3. Check courses you teach:

   (1) ____ Biology
   (2) ____ Chemistry
   (3) ____ Physics
   (4) ____ Earth Science
   (5) ____ Other Science (Please specify)
   (6) ____ Other (Please specify)

4. Type of school in which you teach:

   (1) ____ Four year high school
   (2) ____ Three year high school
   (3) ____ Six year junior-senior high school
   (4) ____ Other (Please specify) _____

5. Approximate enrollment in grades 10-12 of the high school in which you teach ____.

6. A. State in which you obtained the baccalaureate degree _____.

   B. State in which you obtained highest degree completed _____.

7. How long do you feel you will remain in teaching?

   (1) ____ Only a few years
   (2) ____ Permanent career
   (3) ____ Undecided

8. Number of semester hours of science completed during your undergraduate work: (Check appropriate column opposite each course)

| Semester Hours | None | 1-10 | 11-20 | 21-30 | 31-40 | Over 40 |
|---|---|---|---|---|---|---|
| Biology | | | | | | |
| Chemistry | | | | | | |
| Physics | | | | | | |
| Other (Specify) | | | | | | |

9. Number of semester hours of science you have taken since the completion of the baccalaureate degree: (Check appropriate column opposite each course)

| Semester Hours | None | 1-10 | 11-20 | 21-30 | 31-40 | Over 40 |
|---|---|---|---|---|---|---|
| Biology | | | | | | |
| Chemistry | | | | | | |
| Physics | | | | | | |
| Others (Specify) | | | | | | |

10. How many of the hours indicated in question 9 could be counted or were counted on a graduate degree? (Check appropriate column opposite each course)

| Semester Hours | None | 1-10 | 11-20 | 21-30 | 31-40 | Over 40 |
|---|---|---|---|---|---|---|
| Biology | | | | | | |
| Chemistry | | | | | | |
| Physics | | | | | | |
| Others (Specify) | | | | | | |

11. Type of undergraduate degree you have completed:

(1) ____ Bachelor of Arts with a major or minor in science. (Specify field _____)
(2) ____ Bachelor of Science with a major or minor in science. (Specify field _____)
(3) ____ Bachelor of Science in Education with a major or minor in science. (Specify field _____)
(4) ____ Other (Specify _____)

12. Kind of institution where you completed your undergraduate degree: (Check one in A and B below)

A. Type of institution:

(1) ____ State University
(2) ____ State College
(3) ____ Privately Endowed University or College

B. Approximate enrollment of institution at time of your attendance:

(1) ____ Less than 500
(2) ____ 500 to 2,499
(3) ____ 2,500 to 5,000
(4) ____ 5,000 and over

13. Type of advanced degree you have completed or are in the process of completing:

(1) ____ Master's in science with no education courses.
(Specify science area _____)
(2) ____ Master's in education with a major or minor in science.
(Specify area _____)
(3) ____ Master's in education with no science courses.
(4) ____ Master of teaching degree with science concentration.
(Specify area _____)
(5) ____ Doctorate: Type _____.
Major _____.
(6) ____ Other (Please specify _____)

14. Date advanced degree was granted:

Master's _____
Doctorate _____

15. Kind of institution where you completed or have done work on your master's degree: (Check one in A and B below)

A. Type of institution:

(1) ____ State University
(2) ____ State College
(3) ____ Privately Endowed University or College

B. Approximate enrollment of institution at time of your attendance:

(1) ____ Less than 500
(2) ____ 500 to 2,499
(3) ____ 2,500 to 5,000
(4) ____ Over 5,000

16. Kind of institution where you completed or have done work on your doctorate degree: (Check one in A and B below)

A. Type of institution:

(1) ____ State University
(2) ____ State College
(3) ____ Privately Endowed University or College

B. Approximate enrollment of institution at time of your attendance:

(1) ____ Less than 500
(2) ____ 500 to 2,499
(3) ____ 2,500 to 5,000
(4) ____ Over 5,000

PART TWO:

OPINIONS OF SCIENCE TEACHERS CONCERNING THE FIFTH-YEAR-GRADUATE PROGRAM OF TEACHER EDUCATION

Please check the appropriate responses to the following statements relative to the fifth year of teacher education for teachers of high school science.

You will notice two sets of columns requiring your responses. The first set is for your responses based upon your experience in the first year of graduate study. The sixth column in the first set is to be checked if your graduate program did not include experience relative to the item. The second set is for your responses as recommendations for a fifth-year program of teacher education on the graduate level as it should be, based on the value you would place on the item.

PLEASE READ EACH STATEMENT CAREFULLY. ANSWER ALL STATEMENTS. PLEASE REMEMBER THAT EACH STATEMENT REQUIRES TWO ANSWERS.

| | Your Experience | | | | | | Your Recommendations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | High Value | Moderate Value | Undecided | Little Value | Of No Value | No Experience | Agree Completely | Tend to Agree | Undecided | Tend to Disagree | Disagree Completely |
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 |
| 1. Provide teachers of high school science with an opportunity to improve their cultural backgrounds by taking some work in cultural fields outside the science and professional education fields. | | | | | | | | | | | |
| 2. Provide in-service courses for individual or group study of local science education problems for which credit is received. | | | | | | | | | | | |
| 3. Provide a general course in school administration for a better understanding of the job of the school superintendent and principal | | | | | | | | | | | |

| | Your Experience | | | | | | Your Recommendations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 High Value | 2 Moderate Value | 3 Undecided | 4 Little Value | 5 Of No Value | 6 No Experience | 1 Agree Completely | 2 Tend to Agree | 3 Undecided | 4 Tend to Disagree | 5 Disagree Completely |
| 4. Provide workshops that combine the scientific disciplines for a better understanding of their interdependence. | | | | | | | | | | | |
| 5. Require the completion of a thesis for the master's degree. | | | | | | | | | | | |
| 6. Provide formal science courses which place emphasis on theoretical knowledge and technical skills without reference to classroom teaching. | | | | | | | | | | | |
| 7. Emphasize scientific research from the point of view of preparing teachers to become intelligent consumers of such research. | | | | | | | | | | | |
| 8. Emphasize educational research from the point of view of preparing teachers to become intelligent consumers of such research. | | | | | | | | | | | |
| 9. Provide opportunities for the teacher to apply and extend his professional competence through directed practice teaching at the graduate level. | | | | | | | | | | | |
| 10. Provide adequate laboratory facilities so that teachers may have experience working with audio-visual, curriculum, and laboratory materials related to their particular science area. | | | | | | | | | | | |

| | Your Experience | | | | | | Your Recommendations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 High Value | 2 Moderate Value | 3 Undecided | 4 Little Value | 5 Of No Value | 6 No Experience | 1 Agree Completely | 2 Tend to Agree | 3 Undecided | 4 Tend to Disagree | 5 Disagree Completely |
| 11. Provide the use of laboratory schools (public or college connected) for demonstration, research, and experimentation. | | | | | | | | | | | |
| 12. A flexible program with few specific course requirements in either science or education so that a teacher may elect those courses which best meet his needs. | | | | | | | | | | | |
| 13. Require that the graduate student conduct a research project in science education. | | | | | | | | | | | |
| 14. Use instructional methods in college classes which emphasize demonstrations, class participation, and use of audio-visual aids. | | | | | | | | | | | |
| 15. Provide for research in science education to be taken for credit on an elective basis. | | | | | | | | | | | |
| 16. Students should be encouraged to have at least one year full-time teaching experience before entering the fifth-year program. | | | | | | | | | | | |
| 17. Students should be required to have at least one year of full-time teaching experience before entering the fifth-year program. If you would recommend more experience, please write the number of years here _____. | | | | | | | | | | | |

| | Your Experience | | | | | | Your Recommendations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 High Value | 2 Moderate Value | 3 Undecided | 4 Little Value | 5 Of No Value | 6 No Experience | 1 Agree Completely | 2 Tend to Agree | 3 Undecided | 4 Tend to Disagree | 5 Disagree Completely |
| 18. Include at least one science course taught by the inquiry or discovery approach. | | | | | | | | | | | |
| 19. Encourage research in a science area for credit on an elective basis. | | | | | | | | | | | |
| 20. The fifth year should be a terminal program independent of providing prerequisites for doctoral study. | | | | | | | | | | | |
| 21. So design the program that its completion will enable a person to pursue the doctorate in science education. | | | | | | | | | | | |
| 22. Include a course in the history and/or philosophy of science | | | | | | | | | | | |
| 23. The fifth year should be considered a fifth year of teacher education without awarding a master's degree. | | | | | | | | | | | |
| 24. Provide advanced courses in science areas designed especially for secondary teachers. | | | | | | | | | | | |
| 25. Provide introductory courses in science which are related to his major area and which offer graduate credit, without prerequisites, and are prepared especially for secondary teachers. | | | | | | | | | | | |

| | Your Experience | | | | | | Your Recommendations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 High Value | 2 Moderate Value | 3 Undecided | 4 Little Value | 5 Of No Value | 6 No Experience | 1 Agree Completely | 2 Tend to Agree | 3 Undecided | 4 Tend to Disagree | 5 Disagree Completely |
| 26. The completion of the fifth year should have as a prerequisite the completion of mathematics through algebra, trigonometry, and analytical geometry either as an undergraduate or postgraduate. | | | | | | | | | | | |
| 27. The completion of the fifth year should have as a prerequisite the completion of mathematics through two semesters of calculus either as undergraduate or postgraduate work for the physical science major. | | | | | | | | | | | |
| 28. Require the completion (undergraduate or postgraduate) of a minimum of 10 semester hours in each of the following (regardless of the major science area): biology, chemistry, and physics. | | | | | | | | | | | |
| 29. Include programs designed outside the regular class structure patterned after NSF Institute type programs but not necessarily nationally sponsored with participant stipends. | | | | | | | | | | | |

30. What percentage of the total fifth-year program should be devoted to each of the following on a required basis: (It is not necessary to specify something on every topic.)

(1) Professional Education courses _____%

(2) Science in the major science area _____%

(3) Other science courses _____%

(4) Science education courses _____%

(5) Research _____%

(6) Observation and advanced student teaching _____%

(7) Unrestricted electives _____%

(8) Other required work (please specify) _____%

_____ 100 %

31. A. Should a science specialty such as chemistry, physics, or biology be required as part of the fifth-year program? (Check one)

Yes _____ No _____

B. If yes, what percentage of the total graduate program should it occupy?

_____%

32. Advanced methods courses in science teaching (improvement of instruction courses) should be offered by (Please check one):

(1) Education department giving credit in education _____.

(2) A science department giving credit in science _____.

(3) Either education or science department giving credit in either _____.

(4) Other (Please specify) _____.

33. Which of the following types of backgrounds would best suit a person to teach the advanced methods course? (Please check one)

    (1) Predominately professional education background ____.

    (2) Predominately science background ____.

    (3) Combination of science and education background ____.

    (4) Other (Please specify) _____.

34. A. Do you recognize any felt need for program changes in science, at the college level, to better insure that the high school teacher of science can better handle the new science programs, for example, CBA or CHEM Study chemistry, PSSC physics, BSCS biology, or other?

    Yes ____ No ____

    B. If answer to "A" is "yes", please list suggestions. (Use back if more space is needed.)

    C. Have you had instruction in teaching one or more of the new science programs, for example, CBA or CHEM Study chemistry, PSSC physics, BSCS biology, or other?

    Yes ____ No ____

PART THREE:

The following section of the questionnaire is divided into Groups I through IV. Under Groups I, II, and III courses are listed which might be included in the fifth year of science education. Under Group IV you are asked to list courses you consider to be most valuable for the science teacher in the fifth year of teacher education. Please rank the courses within each group, including Group IV, according to your estimate of their importance in the fifth-year science teacher education. Rank the courses by placing a number (most important, 1; next important, 2; etc.) in the blank in column B. If you have taken or are currently taking the course in college (graduate or undergraduate), place a check (✓) in column A following the course.

| | Courses Taken A | Rank B |
|---|---|---|
| GROUP I. | | |
| Utilization of Audio-Visual Materials . . . . . | ( ) | ( ) |
| Selection of Audio-Visual Materials . . . . . | ( ) | ( ) |
| Making or Preparing Audio-Visual Materials . . . . . | ( ) | ( ) |
| Other (Please specify) _____ . . . . . | ( ) | ( ) |
| GROUP II. | | |
| Extra-curricular Activities . . . . . | ( ) | ( ) |
| Educational Research . . . . . | ( ) | ( ) |
| Educational Psychology . . . . . | ( ) | ( ) |
| Educational Measurements and Evaluation . . . . . | ( ) | ( ) |
| Educational Statistics . . . . . | ( ) | ( ) |
| Guidance . . . . . | ( ) | ( ) |
| Philosophy of Education . . . . . | ( ) | ( ) |
| History of Education . . . . . | ( ) | ( ) |
| Course and Curriculum Development . . . . . | ( ) | ( ) |
| Problems of Teaching . . . . . | ( ) | ( ) |
| Materials and Methods of Instruction . . . . . | ( ) | ( ) |
| Principles of School Administration . . . . . | ( ) | ( ) |

| | Courses Taken A | Rank B |
|---|---|---|
| GROUP III. | | |
| Graduate work in: | | |
| Modern Advances in your major and related science areas . . . . . | ( ) | ( ) |
| Advanced Science Teaching Methods . . . . . | ( ) | ( ) |
| Laboratory Techniques and Preparation of Laboratory Materials . . . . . | ( ) | ( ) |
| Research in a Science Area . . . . . | ( ) | ( ) |
| History of your major science area . . . . . | ( ) | ( ) |
| History and/or Philosophy of Science . . . . . | ( ) | ( ) |
| Calculus . . . . . | ( ) | ( ) |
| Mathematics above calculus . . . . . | ( ) | ( ) |
| GROUP IV. | | |
| A. List courses in your major science area that you consider most valuable to the secondary science teacher. | | |
| (1) _____ . . . . . | ( ) | ( ) |
| (2) _____ . . . . . | ( ) | ( ) |
| (3) _____ . . . . . | ( ) | ( ) |
| (4) _____ . . . . . | ( ) | ( ) |
| (5) _____ . . . . . | ( ) | ( ) |
| B. List courses in related science area or areas that you consider most valuable to the secondary science teacher. | | |
| (1) _____ . . . . . | ( ) | ( ) |
| (2) _____ . . . . . | ( ) | ( ) |
| (3) _____ . . . . . | ( ) | ( ) |
| (4) _____ . . . . . | ( ) | ( ) |
| (5) _____ . . . . . | ( ) | ( ) |

PART FOUR:

Please rank the groups of courses from the previous section (PART THREE) on the basis of the overall value of that group of courses to the high school science teacher in the fifth year of teacher education. Rank the groups by placing a number (most important, 1; next most important, 2; etc.) in the blanks following the groups below:

GROUP I ( )

GROUP II ( )

GROUP III ( )

GROUP IV ( )

Please add any comments concerning the fifth year of science teacher education you wish to make. Any opinions concerning the science program or other phases of the program not covered above will be welcome.

APPENDIX V

PART ONE:

DATA SHEET FOR USE WITH OPINION SURVEY OF SUPERINTENDENTS CONCERNING THE FIFTH-YEAR-GRADUATE PROGRAM OF TEACHER EDUCATION

1. Number of years of experience as superintendent at the close of this year: (Check one)

(1) ____ Less than one year
(2) ____ 1 to 3 years
(3) ____ 4 to 6 years
(4) ____ 7 to 10 years
(5) ____ More than 10 years

2. Approximate enrollment of the high school of which you are superintendent: (Check one) (Grades 10-12)

(1) ____ Less than 100
(2) ____ 100 to 299
(3) ____ 300 to 499
(4) ____ 500 to 699
(5) ____ 700 to 1,000
(6) ____ Over 1,000

3. Number of years classroom teaching experience: (More than half time in classroom) (Check one)

(1) ____ 1 to 3 years
(2) ____ 4 to 6 years
(3) ____ 7 to 10 years
(4) ____ More than 10 years

4. Teaching fields: (Check)

(1) ____ Business Education
(2) ____ Science
(3) ____ Language Arts
(4) ____ Physical Education
(5) ____ Industrial Arts
(6) ____ Mathematics
(7) ____ Social Studies
(8) ____ Other (Please specify) _____.

5. Approximate number of semester hours of science you have taken: (Check one in both A and B below)

A. Undergraduate:

(1) ____ None
(2) ____ 1-9 semester hours
(3) ____ 10-19 semester hours
(4) ____ 20-29 semester hours
(5) ____ 30-40 semester hours
(6) ____ Over 40 semester hours

B. Graduate:

(1) ____ None
(2) ____ 1-9 semester hours
(3) ____ 10-19 semester hours
(4) ____ 20-29 semester hours
(5) ____ 30-40 semester hours
(6) ____ Over 40 semester hours

6. Highest degree completed: (Specify) _____.

   Major _____ Minor _____

7. Kind of institution where you completed or have done work on your master's degree: (Check one in both A and B below)

   A. Type of Institution:

   (1) ____ State University
   (2) ____ State College
   (3) ____ Privately endowed University or College

   B. Approximate enrollment of institution at time of your attendance:

   (1) ____ Less than 500
   (2) ____ 500 to 2,499
   (3) ____ 2,500 to 5,000
   (4) ____ Over 5,000

8. Kind of institution where you completed or have done work on your doctorate degree: (Check one in both A and B below)

   A. Type of Institution:

   (1) ____ State University
   (2) ____ State College
   (3) ____ Privately endowed University or College

   B. Approximate enrollment of institution at time of your attendance:

   (1) ____ Less than 500
   (2) ____ 500 to 2,499
   (3) ____ 2,500 to 5,000
   (4) ____ Over 5,000

PART TWO:

OPINIONS OF SUPERINTENDENTS CONCERNING THE FIFTH-YEAR-GRADUATE PROGRAM OF TEACHER EDUCATION

Please check the appropriate responses to the following statements relative to the fifth year of teacher education for teachers of high school science.

You will notice two sets of columns requiring your responses. The first set is for your responses based upon your experience in the first year of graduate study. The sixth column in the first set is to be checked if your graduate program did not include experience relative to the item. The second set is for your responses as recommendations for a fifth-year program of teacher education on the graduate level as it should be, based on the value you would place on the item.

PLEASE READ EACH STATEMENT CAREFULLY. ANSWER ALL STATEMENTS. PLEASE REMEMBER THAT EACH STATEMENT REQUIRES TWO ANSWERS.

| | Your Experience | | | | | | Your Recommendations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 High Value | 2 Moderate Value | 3 Undecided | 4 Little Value | 5 Of No Value | 6 No Experience | 1 Agree Completely | 2 Tend to Agree | 3 Undecided | 4 Tend to Disagree | 5 Disagree Completely |
| 1. Provide teachers of high school science with an opportunity to improve their cultural backgrounds by taking some work in cultural fields outside the science and professional education fields. | | | | | | | | | | | |
| 2. Provide in-service courses for individual or group study of local science education problems for which credit is received. | | | | | | | | | | | |
| 3. Provide a general course in school administration for a better understanding of the job of the school superintendent and principal. | | | | | | | | | | | |

| | Your Experience | | | | | | Your Recommendations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 High Value | 2 Moderate Value | 3 Undecided | 4 Little Value | 5 Of No Value | 6 No Experience | 1 Agree Completely | 2 Tend to Agree | 3 Undecided | 4 Tend to Disagree | 5 Disagree Completely |
| 4. Provide workshops that combine the scientific disciplines for a better understanding of their interdependence. | | | | | | | | | | | |
| 5. Require the completion of a thesis for the master's degree. | | | | | | | | | | | |
| 6. Provide formal science courses which place emphasis on theoretical knowledge and technical skills without reference to classroom teaching. | | | | | | | | | | | |
| 7. Emphasize scientific research from the point of view of preparing teachers to become intelligent consumers of such research. | | | | | | | | | | | |
| 8. Emphasize educational research from the point of view of preparing teachers to become intelligent consumers of such research. | | | | | | | | | | | |
| 9. Provide opportunities for the teacher to apply and extend his professional competence through directed practice teaching at the graduate level. | | | | | | | | | | | |
| 10. Provide adequate laboratory facilities so that teachers may have experience working with audio-visual, curriculum, and laboratory materials related to their particular science area. | | | | | | | | | | | |

| | Your Experience | | | | | | Your Recommendations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | High Value | Moderate Value | Undecided | Little Value | Of No Value | No Experience | Agree Completely | Tend to Agree | Undecided | Tend to Disagree | Disagree Completely |
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 |
| 11. Provide the use of laboratory schools (public or college connected) for demonstration, research, and experimentation. | | | | | | | | | | | |
| 12. A flexible program with few specific course requirements in either science or education so that a teacher may elect those courses which best meet his needs. | | | | | | | | | | | |
| 13. Require that the graduate student conduct a research project in science education. | | | | | | | | | | | |
| 14. Use instructional methods in college classes which emphasize demonstrations, class participation, and use of audio-visual aids. | | | | | | | | | | | |
| 15. Provide for research in science education to be taken for credit on an elective basis. | | | | | | | | | | | |
| 16. Students should be encouraged to have at least one year full-time teaching experience before entering the fifth-year program. | | | | | | | | | | | |
| 17. Students should be required to have at least one year of full-time teaching experience before entering the fifth-year program. If you would recommend more experience, please write the number of years here ____. | | | | | | | | | | | |

| | Your Experience | | | | | | Your Recommendations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 High Value | 2 Moderate Value | 3 Undecided | 4 Little Value | 5 Of No Value | 6 No Experience | 1 Agree Completely | 2 Tend to Agree | 3 Undecided | 4 Tend to Disagree | 5 Disagree Completely |
| 18. Include at least one science course taught by the inquiry or discovery approach. | | | | | | | | | | | |
| 19. Encourage research in a science area for credit on an elective basis. | | | | | | | | | | | |
| 20. The fifth year should be a terminal program independent of providing prerequisites for doctoral study. | | | | | | | | | | | |
| 21. So design the program that its completion will enable a person to pursue the doctorate in science education. | | | | | | | | | | | |
| 22. Include a course in the history and/or philosophy of science. | | | | | | | | | | | |
| 23. The fifth year should be considered a fifth year of teacher education without awarding a master's degree. | | | | | | | | | | | |
| 24. Provide advanced courses in science areas designed especially for secondary teachers. | | | | | | | | | | | |
| 25. Provide introductory courses in science which are related to his major area and which offer graduate credit, without prerequisites, and are prepared especially for secondary teachers. | | | | | | | | | | | |

| | Your Experience | | | | | | Your Recommendations | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 High Value | 2 Moderate Value | 3 Undecided | 4 Little Value | 5 Of No Value | 6 No Experience | 1 Agree Completely | 2 Tend to Agree | 3 Undecided | 4 Tend to Disagree | 5 Disagree Completely |
| 26. The completion of the fifth year should have as a prerequisite the completion of mathematics through algebra, trigonometry, and analytical geometry either as an undergraduate or postgraduate. | | | | | | | | | | | |
| 27. The completion of the fifth year should have as a prerequisite the completion of mathematics through two semesters of calculus either as undergraduate or postgraduate work for the physical science major. | | | | | | | | | | | |
| 28. Require the completion (undergraduate or postgraduate) of a minimum of 10 semester hours in each of the following (regardless of the major science area): biology, chemistry, and physics. | | | | | | | | | | | |
| 29. Include programs designed outside the regular class structure patterned after NSF Institute type programs but not necessarily nationally sponsored with participant stipends. | | | | | | | | | | | |

30. What percentage of the total fifth-year program should be devoted to each of the following on a required basis: (It is not necessary to specify something on every topic.)

(1) Professional education courses _____%

(2) Science in the major science area _____%

(3) Other science courses _____%

(4) Science education courses _____%

(5) Research _____%

(6) Observation and advanced student teaching _____%

(7) Unrestricted electives _____%

(8) Other required work (Please specify) _____%

_____ 100 %

31. A. Should a science specialty such as chemistry, physics, or biology be required as part of the fifth-year program? (Check one)

Yes _____ No _____

B. If yes, what percentage of the total graduate program should it occupy?

_____%

32. Advanced methods courses in science teaching (improvement of instruction courses) should be offered by (Please check one):

(1) Education department giving credit in education. _____.

(2) A science department giving credit in science _____.

(3) Either education or science department giving credit in either _____.

(4) Other (Please specify) _____.

33. Which of the following types of backgrounds would best suit a person to teach the advanced methods course? (Please check one)

    (1) Predominately professional education background ____.

    (2) Predominately science background ____.

    (3) Combination of science and education background ____.

    (4) Other (Please specify) _____.

34. A. Do you recognize any felt need for program changes in science, at the college level, to better insure that the high school teacher of science can better handle the new science programs, for example, CBA or CHEM Study chemistry, PSSC physics, BSCS biology, or other?

    Yes ____ No ____

    B. If answer to "A" is "yes", please list suggestions. (Use back if more space is needed.)

    C. Have you had instruction in teaching one or more of the new science programs, for example, CBA or CHEM Study chemistry, PSSC physics, BSCS biology, or other?

    Yes ____ No ____

PART THREE:

The following section of the questionnaire is divided into Groups I through IV. Under Groups I, II, and III courses are listed which might be included in the fifth year of science education. Under Group IV you are asked to list courses you consider to be most valuable for the science teacher in the fifth year of teacher education. Please rank the courses within each group, including Group IV, according to your estimate of their importance in the fifth-year science teacher education. Rank the courses by placing a number (most important, 1; next most important, 2; etc.) in the blank in column B. If you have taken or are currently taking the course in college (graduate or undergraduate), place a check (✓) in column A following the course.

| | Courses Taken A | Rank B |
|---|---|---|
| GROUP I. | | |
| Utilization of Audio-Visual Materials . . . . . | ( ) | ( ) |
| Selection of Audio-Visual Materials . . . . . | ( ) | ( ) |
| Making or Preparing Audio-Visual Materials . . . . . | ( ) | ( ) |
| Other (Please specify) _____ . . . . . | ( ) | ( ) |
| GROUP II. | | |
| Extra-curricular Activities . . . . . | ( ) | ( ) |
| Educational Research . . . . . | ( ) | ( ) |
| Educational Psychology . . . . . | ( ) | ( ) |
| Educational Measurements and Evaluation . . . . . | ( ) | ( ) |
| Educational Statistics . . . . . | ( ) | ( ) |
| Guidance . . . . . | ( ) | ( ) |
| Philosophy of Education . . . . . | ( ) | ( ) |
| History of Education . . . . . | ( ) | ( ) |
| Course and Curriculum Development . . . . . | ( ) | ( ) |
| Problems of Teaching . . . . . | ( ) | ( ) |
| Materials and Methods of Instruction . . . . . | ( ) | ( ) |
| Principles of School Administration . . . . . | ( ) | ( ) |

GROUP III.

| | Courses Taken A | Rank B |
|---|---|---|
| Graduate Work in: | | |
| Modern Advances in your major or related science areas . . . . . | ( ) | ( ) |
| Advanced Science Teaching Methods . . . . . | ( ) | ( ) |
| Laboratory Techniques and Preparation of Laboratory Materials . . . . . | ( ) | ( ) |
| Research in a science area . . . . . | ( ) | ( ) |
| History of your major science area . . . . . | ( ) | ( ) |
| History and/or Philosophy of Science . . . . . | ( ) | ( ) |
| Calculus . . . . . | ( ) | ( ) |
| Mathematics above Calculus . . . . . | ( ) | ( ) |

GROUP IV.

List courses, general and specific, in science and mathematics that you consider to be valuable to science teachers in the subject areas below that might be taken as a part of the approximately 32 semester hour fifth-year program. You may wish to indicate the number of semester hours to be devoted to the courses you suggest. If you have no suggestions for a subject area, so indicate by leaving the area blank and going on to PART FOUR.

| A. Biology Teacher | Semester Hours | Courses Taken A | Rank B |
|---|---|---|---|
| Biology | | | |
| (1) _____ . . . . . | _____ | ( ) | ( ) |
| (2) _____ . . . . . | _____ | ( ) | ( ) |
| (3) _____ . . . . . | _____ | ( ) | ( ) |
| (4) _____ . . . . . | _____ | ( ) | ( ) |
| (5) _____ . . . . . | _____ | ( ) | ( ) |

| | Semester Hours | Courses Taken A | Rank B |
|---|---|---|---|
| Related Courses | | | |
| (1) _____ | _____ | ( ) | ( ) |
| (2) _____ | _____ | ( ) | ( ) |
| (3) _____ | _____ | ( ) | ( ) |
| (4) _____ | _____ | ( ) | ( ) |
| (5) _____ | _____ | ( ) | ( ) |
| B. Chemistry Teacher | | | |
| Chemistry | | | |
| (1) _____ | _____ | ( ) | ( ) |
| (2) _____ | _____ | ( ) | ( ) |
| (3) _____ | _____ | ( ) | ( ) |
| (4) _____ | _____ | ( ) | ( ) |
| (5) _____ | _____ | ( ) | ( ) |
| Related Courses | | | |
| (1) _____ | _____ | ( ) | ( ) |
| (2) _____ | _____ | ( ) | ( ) |
| (3) _____ | _____ | ( ) | ( ) |
| (4) _____ | _____ | ( ) | ( ) |
| (5) _____ | _____ | ( ) | ( ) |

| | | Semester Hours | Courses Taken A | Rank B |
|---|---|---|---|---|
| C. | Physics Teacher | | | |
| | Physics | | | |
| | (1) _____ | _____ | ( ) | ( ) |
| | (2) _____ | _____ | ( ) | ( ) |
| | (3) _____ | _____ | ( ) | ( ) |
| | (4) _____ | _____ | ( ) | ( ) |
| | (5) _____ | _____ | ( ) | ( ) |
| | Related Courses | | | |
| | (1) _____ | _____ | ( ) | ( ) |
| | (2) _____ | _____ | ( ) | ( ) |
| | (3) _____ | _____ | ( ) | ( ) |
| | (4) _____ | _____ | ( ) | ( ) |
| | (5) _____ | _____ | ( ) | ( ) |
| D. | Junior High School Science Teacher | | | |
| | Science | | | |
| | (1) _____ | _____ | ( ) | ( ) |
| | (2) _____ | _____ | ( ) | ( ) |
| | (3) _____ | _____ | ( ) | ( ) |
| | (4) _____ | _____ | ( ) | ( ) |
| | (5) _____ | _____ | ( ) | ( ) |

| | Semester Hours | Courses Taken A | Rank B |
|---|---|---|---|
| Related Courses | | | |
| (1) _____ | _____ | ( ) | ( ) |
| (2) _____ | _____ | ( ) | ( ) |
| (3) _____ | _____ | ( ) | ( ) |
| (4) _____ | _____ | ( ) | ( ) |
| (5) _____ | _____ | ( ) | ( ) |
| E. Chemistry - Biology Teacher | | | |
| Chemistry and Biology | | | |
| (1) _____ | _____ | ( ) | ( ) |
| (2) _____ | _____ | ( ) | ( ) |
| (3) _____ | _____ | ( ) | ( ) |
| (4) _____ | _____ | ( ) | ( ) |
| (5) _____ | _____ | ( ) | ( ) |
| Related Courses | | | |
| (1) _____ | _____ | ( ) | ( ) |
| (2) _____ | _____ | ( ) | ( ) |
| (3) _____ | _____ | ( ) | ( ) |
| (4) _____ | _____ | ( ) | ( ) |
| (5) _____ | _____ | ( ) | ( ) |

| F. Chemistry-Physics Teacher | Semester Hours | Courses Taken A | Rank B |
|---|---|---|---|
| Chemistry and Physics | | | |
| (1) _____ . . . . . | _____ | ( ) | ( ) |
| (2) _____ . . . . . | _____ | ( ) | ( ) |
| (3) _____ . . . . . | _____ | ( ) | ( ) |
| (4) _____ . . . . . | _____ | ( ) | ( ) |
| (5) _____ . . . . . | _____ | ( ) | ( ) |
| Related Courses | | | |
| (1) _____ . . . . . | _____ | ( ) | ( ) |
| (2) _____ . . . . . | _____ | ( ) | ( ) |
| (3) _____ . . . . . | _____ | ( ) | ( ) |
| (4) _____ . . . . . | _____ | ( ) | ( ) |
| (5) _____ . . . . . | _____ | ( ) | ( ) |

PART FOUR:

Please rank the GROUPS of courses from the previous section (PART THREE) on the basis of the overall value of that group of courses to the high school science teacher in the fifth year of teacher education. Rank the groups by placing a number (most important, 1; next most important, 2; etc.) in the blanks following the groups below:

GROUP I ( )

GROUP II ( )

GROUP III ( )

GROUP IV ( )

Please add any comments concerning the fifth year of science teacher education you wish to make. Any opinions concerning the science program or other phases of the program not covered above will be welcome.